ABSTRACTS OF LECTURES

AND POSTERS

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Oral presentations

1 AXIN2, MSX1, AND PAX9 MUTATIONS IN OLIGODONTIA

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AIM: Dominant mutations in transcription factors MSX1 and PAX9 have been described in familial oligodontia. It has been shown that oligodontia and predisposition to cancer are caused by a nonsense mutation in the Wnt-signalling regulator AXIN2. The mutation was found in a family where 11 members lacked at least eight permanent teeth. Colorectal cancer or pre-cancerous lesions were also found in eight oligodontia patients. In addition, a frameshift mutation in AXIN2 was identified in an unrelated young patient. The aim of this study was to investigate the phenotypes and to screen mutations of AXIN2, MSX1, and PAX9 in patients with severe tooth agenesis

SUBJECTS AND METHOD: Twenty-four patients with six or more missing permanent teeth were selected. The patients were examined clinically and panoramic radiographs were taken. Information on general health and familial occurrence of tooth agenesis was obtained by interview. DNA was isolated from venous blood samples and for mutation screening, sequencing of AXIN2-, MSX1-, and PAX9-coding regions was performed.

RESULTS: Tooth agenesis was familial in 19 cases. The mean number of missing teeth was 12 (range 6-20), including third molars. The missing teeth were the premolars, upper lateral incisors, lower incisors, and molars. Some or all canines were lacking in six patients. Four patients had peg-shaped upper lateral incisors and two reported missing upper primary lateral incisors. Two had juvenile idiopathic arthritis, six suffered from an allergy, and two, lactose intolerance. In three families there were some cases of colorectal cancer.

CONCLUSIONS: Oligodontia, like hypodontia, is phenotypically and genetically heterogeneous. As tooth agenesis may be an indicator of cancer, with susceptibility in families with oligodontia caused by mutations in AXIN2, more studies are needed to establish the frequency of AXIN2 mutations and whether mutations in other genes cause both tooth agenesis and cancer susceptibility.

2 ROOT REPAIR AFTER INJURY FROM MINI-IMPLANTS

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AIM: When mini-implants are inserted between the roots of teeth, a risk exists that a root may be accidentally damaged. The aim of this investigation was to describe three cases where complete repair of the root defect was observed.

MATERIALS AND METHOD: In an experimental animal study, 20 mini-screws [bracket screw bone anchors (BSBAs) Vrije Universiteit Brussels, Belgium] were inserted into the mandible of five beagle dogs. Each dog received two BSBAs between the roots of second and third, and third and fourth premolars in each lower quadrant. Every 6 weeks, the animals were subjected to sequential point labelling with vital staining, and apical radiographs were taken. After a period of 25 weeks, the dogs were sacrificed and the specimens were prepared for histological evaluation.

RESULTS: Six screws were inserted very close to the roots of neighbouring teeth. Three became loose within the first 6 weeks after insertion and had to be removed. On the apical radiographs a defect in the neighbouring roots could be observed. On the histological slides, coloured with toluidine blue, almost complete repair of the cementum lining the root could be seen. When examined under a fluorescence microscope, repair by cementoblastic activity was seen along the root as shown by vital staining.

CONCLUSION: Insertion of mini-screws in the alveolar process between the roots of teeth is a critical procedure. In this animal experimental study, at least three roots were obviously damaged by the BSBAs. In all three cases a defect was seen in the root, but almost complete repair of the

cementum lining the root occurred. It must be stressed that these findings are drawn from only three cases and they should be verified in a larger sample before conclusions can be drawn concerning the safe use of mini-screws between the roots of teeth.

3 MECHANOTRANSDUCTION PATHWAYS IN LOADED MANDIBULAR CONDYLAR CARTILAGE

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AIM: Mechanical loading of joints during function plays a significant role in chondro-osteogenesis. However, the molecular mechanism(s) by which mechanical loading is transduced in biological response in chondrocytes remains unclear. It has been shown that the mitogen-activated protein kinase pathways and the activator protein-1 (AP-1) transcription complex are implicated in mechanically stimulated osteoblast differentiation. The aim of the present study was to explore the effect of mechanical loading of mandibular condylar cartilage on the maturation/differentiation status of chondrocytes.
MATERIALS AND METHOD: Fourteen-day-old Wistar rats were separated into two groups: one group was fed a hard diet (physiologic loading), and the other a soft diet (decreased loading). Biopsies from the temporomandibular joints of both groups were obtained at 2, 6, 12, 24, and 48 hours and immunohistochemistry was used to evaluate the expression levels of members of the AP-1 transcription complex (pc-Jun, c-Fos), p-JNK (phosphorylated form of JNK2), p-ERK (phosphorylated ERK species), Runx2, Sox9, Ihh.
RESULTS: The protein levels of pc-Jun, c-Fos, p-JNK, p-ERK, Runx2, were significantly higher at 48 hours in rats fed a hard diet, and their immunoexpression significantly increased between 2 and 48 hours.
CONCLUSIONS: Condylar cartilage loading during function triggers the AP-1 and Runx2 transcription factors through the MAPK signalling pathway. These results indicate that this functional loading regulates the differentiation/maturation process of the condylar chondrocytes and intervenes with the growth process of the condylar cartilage tissue.

4 POST-RETENTION CHANGES OF LOWER INCISOR ALIGNMENT

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AIM: Relapse of orthodontic treatment often involves the recurrence of mandibular crowding. The aim of this study was to investigate the post-retention development of lower incisor irregularity in subjects treated with fixed appliances and in untreated cases.
SUBJECTS AND METHOD: One hundred and forty four patients who had been treated with edgewise appliances and 74 subjects who received no treatment in the lower arch were selected. The five contact points located between the lower canines were assessed on photographs taken from study models at T1 (before treatment), T2 (end of active treatment) and T3 (at least 5 years after retention). The displacement of the adjacent mesial tooth of each contact point was registered with a score ranging from 1-7 as follows: 1) severe lingual displacement, 2) moderate lingual displacement, 3) light lingual displacement, 4) full alignment, 5) slight labial displacement, 6) moderate labial displacement, 7) severe labial displacement. Data for all contact points were pooled and the amount of relapse occurring between T2 and T3 was analyzed.
RESULTS: 'Treated' contact points where the mesial tooth was displaced lingually before treatment showed a greater tendency for stability between T2 and T3 than those contact points in which the mesial tooth was displaced labially. Of all treated contact points, 12-15 per cent, showed a tendency to displace towards the contralateral side after retention. In untreated cases, contact points that spontaneously aligned at T2 generally remained unchanged at T3 although some recurrence of the previous malalignment was found, irrespective of the direction of displacement.

CONCLUSIONS: There appears to be a trend towards gradual labial displacement of mesially located anterior teeth that may be caused by an imbalance between tongue and lip pressure. Orthodontic retraction may enhance tongue pressure, thus leading to relapse.

5 MINI- AND MICRO-SCREWS AS TEMPORARY SKELETAL ANCHORAGE IN ORTHODONTICS

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AIM: Mini- and micro-screws are often used in orthodontics to achieve skeletal anchorage. The present study aimed to investigate prognostic factors for the stability of such screws and to analyze the clinical outcome of the treated patients.
MATERIALS AND METHOD: Over 200 mini-and micro-screws from several manufacturers were placed in more than 70 patients. All screws were immediately loaded.
RESULTS: The survival rates were generally high. In the mandible and the palatal area of the maxilla, mini-screws with a larger diameter showed improved survival rates, whereas in the maxilla (buccally), smaller implants were more successful. The length of the inserted screw was also an important prognostic factor. No severe complications were observed, and the treatment goal was achieved in most of the patients.
CONCLUSION: Mini- and micro-screws are an interesting therapeutic option in orthodontic treatment. Even with immediate loading high success rates can be achieved, and the results are predictable when the implant design is individually chosen. Careful clinical examination before surgery is important.

6 CENTRE OF RESISTANCE AND STRESS DISTRIBUTION AROUND ORTHODONTICALLY LOADED TEETH

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AIM: Whether morphological abnormalities and root deformities could affect orthodontic tooth movement has been discussed in the literature. Possible effects might be a change in the location of the centre of resistance (CR) or an increase in the maximum stresses in the periodontal ligament (PDL) around the deformity, potentially resulting in increased root resorption. The aim of this study was to model several root abnormalities and to determine their influence on initial tooth mobility using numerical methods.
MATERIALS AND METHOD: Consecutive histological sections of extracted upper and lower central incisors served to generate three-dimensional finite element models (FEM) of the respective teeth. These models were interactively modified to generate the following deformities in the FEM: Distal and posterior dilaceration of the root tip by 25 and 50 per cent of the root diameter, pipette-shaped deformation of the root by 20-40 per cent of the diameter, and shortening of the root by 20-50 per cent of its length. Using the FE-package, COSMOS/M2.8, the following tooth displacements were simulated: rotation around the CR (M = 10 Nmm), translation (F = 1 N, M = –10 and 4.5 Nmm), tipping (F = 1 N) and intrusion/extrusion (F = ± 0.5 N). The material parameters were taken from earlier studies.
RESULTS: As an example, dilaceration of the root tip resulted in a dislocation of the CR on the side of the deformity in an apical direction by up to 50 per cent. The maximum stresses increased markedly around the deformities. In the region of the dilacerated and the pipette-shaped teeth, stresses increased from 20 to 40 kPa and decreased at the alveolar crest. The stresses were significantly higher than the capillary blood pressure.
CONCLUSION: The type and extent of root abnormalities have an important effect on the position of the CR. The same holds true for stress distribution. Maximum stresses are located in the region of the abnormality, increasing the risk of root resorption.

7 EFFECTIVENESS AND SUCCESS RATE OF ACTIVATOR TREATMENT

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AIM: To analyse, in a multicentre, retrospective study the effectiveness and success rate of activator treatment of Class II division 1 malocclusions.
SUBJECTS AND METHOD: All patients treated with an activator between 1985-2001 in Giessen and between 1992-2002 in Berne, who fulfilled the following selection criteria (Class II division 1 malocclusion, no aplasia, no extraction of permanent teeth, no syndromes, no previous orthodontic treatment, except transverse maxillary expansion, available records) were included in the study. There were 222 patients (97 female, 125 male) with a mean age of 10.6 years. Three different types of activators had been used: Andresen, van Beek and Herren. Pre-treatment lateral head films and study models from before and after activator treatment were analysed. Data on compliance and further orthodontic treatment performed after the activator phase were derived from the patient records. Treatment was classified as successful when the molar relationship improved by at least ½ or ¾ premolar width, depending on whether or not the leeway space was still available before treatment.
RESULTS: The success rate was almost identical at both departments (65 per cent in Giessen and 66 per cent in Berne) and proved to be independent of age, gender, dental maturity, type of activator, ML/NSL and ML/NL. The successful group exhibited a significantly smaller pre-treatment ANB ($P < 0.05$), as well as better co-operation ($P < 0.001$). In 27 per cent of the patients at both departments, no further orthodontic treatment was performed after the activator phase.
CONCLUSION: In approximately one-third (27 per cent) of Class II division 1 malocclusions orthodontic treatment can be expected to be completed by means of activator treatment and transverse maxillary expansion (if required). For an additional 38 per cent of the patients marked improvements in occlusal relationship were found.

8 NON-INVASIVE ASSESSMENT OF MOTOR-UNIT PHYSIOLOGY IN JAW-ELEVATOR MUSCLES

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AIM: The effects of muscular pain and fatigue on the mechanical properties of the single motor unit of the jaw elevator muscles are not well known. The aims of this study were: 1) to evaluate the possible use of surface electromyographic (EMG) variables (amplitude and spectral) as objective fatigue indices, 2) to compare the myoelectric manifestations of muscle fatigue in the temporalis and masseter muscles during isometric sustained contractions at different force levels, and 3) to assess recovery of the two muscles after sustained contraction.
SUBJECTS AND METHOD: The study was performed bilaterally on the masseter and anterior temporalis muscles of 18 healthy volunteers. An intraoral compressive-force sensor was used to measure the voluntary contraction forces in the intercuspal position and to provide a visual feedback to the subject. EMG signals were recorded during different force levels.
RESULTS: 1) The MNF slope can be used as an index of muscle fatigue, differentiating between fatigue development at different force levels, 2) ARV does not present any typical trend with fatigue, 3) the anterior temporalis and masseter muscles present the same myoelectric manifestations of fatigue at the different contraction levels, 4) during a high force (80 per cent MVC) sustained contraction, pain induced in the masseter region prevented maintenance of the force, 5) pain in the masseter region inhibited motor unit activities which caused a decrease of EMG ARV during sustained contraction, 6) this inhibition was not present in the anterior temporalis, 7) the muscle fibre membrane properties (assessed by relative changes of MNF) changed by the same amount in the two muscles, 8) the latter properties (peripheral) recovered

rapidly (2 minutes) in both muscles.
CONCLUSION: The activity of masseter motor units seems to be influenced to a greater extent by pain.

9 FINITE ELEMENT ANALYSIS OF STRESS AND STRAIN AROUND ORTHODONTICALLY LOADED IMPLANTS: AN ANIMAL STUDY

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AIM: 1) to describe stresses around orthodontically loaded dental implants; 2) to estimate the resulting strain on the basis of finite element model (FEM) analyses; 3) to evaluate the relationship between the generated strain and the biological reaction expressed through histomorphometric parameters; 4) to evaluate the interaction between orthodontic loading and deformations generated by occlusal function.
MATERIALS AND METHOD: Sixteen titanium implants inserted in the jaws of four monkeys were loaded after 14 weeks of healing with a total of 50 cN for 15 weeks. After sacrifice, the jaw segments were excised and scanned using a synchrotron radiation-based microtomograph. The resulting three-dimensional reconstructions were used to generate case-specific FEMs where the *in vivo* loading of the bone could be simulated. The samples were then prepared for histomorphometric analysis and the bone dynamics parameters were measured.
RESULTS: Micro-computed tomographic scans revealed newly formed bone around the implants, both as an encapsulating cortical shell and as supporting trabecular network. This adapted structure was reflected in the implant to bone load transfer mechanism. However, only trend-like relations between the calculated stresses/strains and the (re)modelling parameters could be found, suggesting that individual morphological features and functional loading of the bone also play a significant role. Moreover stress/strain concentrations around the implant are generated by material properties mismatch.
CONCLUSION: By integrating different analysis techniques to evaluate bone (re)modelling around orthodontically loaded implants, this study has demonstrated the complexity and case-specific characteristics of alveolar adaptation to orthodontic loading. Site-specific and individual differences in local function and bone density have a non-negligible influence on the transfer of orthodontic forces from the implant to the surrounding bone.

10 THE PALATAL RUGAE AS LANDMARKS FOR EVALUATION OF CHANGES ON DIGITAL DENTAL CAST ANALYSIS – ARE THEY REALLY STABLE?

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AIM: Three-dimensional (3D) scanning has made 3D digital superimposition of dental casts possible in order to observe growth or treatment changes. For this, stable references are necessary. In the past the palatal rugae have been shown to be reliable points for the analysis of dental changes on the occlusal plane of the casts. The aim of this study was to determine if the rugae are stable points of reference for evaluation of 3D changes on dental casts.
MATERIALS AND METHOD: The five-year follow-up records of 35 individuals, 15 adults with five and 10 year records (median age 43.8 years) and 20 growing individuals with three and eight year records (median age 14.6 years) were used. The lateral cephalograms were scanned and adjusted for image magnification. The respective dental casts were scanned with a 3D laser scanner and the midline contour of the palatal vault was superimposed on the palatal vault of the cephalograms. The distance of the mesial point of the right rugae from the incisal edge was measured on the dental casts and transferred to the tracing of the corresponding lateral cephalogram. After superimposition of the tracings of the two follow-up records, changes in the rugae position were measured with respect to the palatal plane.
RESULTS: Changes in the perpendicular rugae position with respect to the palatal plane were

observed in both groups; less in the adults (0.94 ± 0.55 mm) than in growing individuals (2.4 ± 0.95 mm; $P < 0.001$). In the sagittal plane, the rugae position showed no statistically significant changes. The position of the upper incisal edge showed similar 3D changes as those of the rugae.
CONCLUSIONS: The vertical palatal rugae position is not stable over time, possibly as a result of long-term dentoalveolar changes. Thus, other stable structures are necessary as references for longitudinal evaluation of digital dental casts.

11 MINI-IMPLANT ACTIVATION AFTER DIFFERENT BONE HEALING PERIODS: A HISTOLOGIC STUDY IN BEAGLE DOGS

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AIM: To histomorphometrically/morphologically evaluate bone response to statically loaded mini-implants activated after different healing periods in a beagle dog model.
MATERIALS AND METHOD: Seventy-eight as-machined surface Ti-6Al-4V mini-implants were placed bilaterally along the mandibular premolar and molar regions of six beagle dogs. Left (experimental) and right (control) quadrants received six and seven mini-implants, respectively. Experimental group healing periods prior to load activation (250g) for 12 weeks, were 0 (immediately activated), 1 and 3 weeks prior to sacrifice. Control mini-implant groups (non-loaded) provided baseline data and were placed 12, 3, and 1 week prior to sacrifice, and on the day of sacrifice. Oxytetracycline and calcein-green were administered 14 days and 48 hours prior to sacrifice. After sacrifice, the mandibles were exposed by sharp dissection and the block specimens were equally divided into two groups, decalcified and non-decalcified and prepared for histomorphometric analyses. Both specimens were evaluated for bone contact to implant surface, and the non-decalcified specimens were divided into regions of interest, which provided bone mean apposition rates at regions close to the mini-implant.
RESULTS: The control groups showed classic bone healing, from implantation necrotic tissue (day of sacrifice group) to mature bone (at 12 weeks *in vivo*). All experimental groups showed mature bone morphology. Bone to implant contact values were not significantly different between the groups, nor were the mean apposition rate values, and these were comparable to values previously obtained for bone around implants in this animal model.
CONCLUSION: These results indicate the possibility of clinical application of orthodontic static loading immediately or soon after implantation.

12 PERCEPTION OF BONE PLATES USED FOR ORTHODONTIC ANCHORAGE: A QUESTIONNAIRE STUDY

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AIM: To evaluate the treatment outcome and acceptance rate of orthodontically loaded bone plates by patients, orthodontists and surgeons.
SUBJECTS AND METHOD: Forty-two bone plates (Bollard, Surgitec) were placed by three surgeons in 21 consecutive patients as orthodontic anchorage reinforcement. Thirty-six anchors were localized in the infrazygomatic crest and six in the mandibular body. The patients and orthodontists were asked to complete questionnaires at 2 weeks and 6 months after surgery. The surgeons completed one questionnaire after placement.
RESULTS: The surgical procedure was considered by the surgeons as very to moderately easy, lasting less than 30 minutes/plate for 19 of the 21 patients. The bone plates were mainly used to distalize molars (23), for orthopaedic Class III traction (8), canine distalization (5), intrusion of anterior teeth (2), intrusion of molars (2), mesialization of molars (1), and traction of an impacted

canine (1). The estimated loading force was 100-200 g. The orthodontists judged the handling complexity of the bone plates at 1.6 ± 0.7 [mean (m) ± standard deviation (sd)] on a scale range of 1: very easy to 4: very difficult. No orthodontist recorded a score of 4. One bone anchor was lost after six months. The patients estimated their pain during surgery as 2.0 ± 1.0 (m ± sd) (1: no pain - 4: very painful). Two patients said they would not be prepared to undergo surgery again to place an implant.
CONCLUSION: This skeletal anchorage system was generally well accepted by patients and reported to be easy to manage by surgeons and orthodontists.

13 SMILE LATERAL BLACK CORRIDORS: AESTHETIC VALUE FOR DENTISTS AND LAYPERSONS

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AIM: To assess the aesthetics of lateral 'black corridors' by dentists and layperson.
MATERIALS AND METHOD: In order to evaluate the significance of lateral black corridors, a smiling photograph (frontal view) was digitized (Scanner HP 5490C, 1200 × 1200 dpi) and modified (Adobe Photoshop 5.0) by a professional computer technician. Three pictures were produced, one with no corridors (N1), another with evident corridors (N2), and a third with moderate corridors (N3). During an interview, 1275 laypersons (413 males, 862 females; 14 to 77 years of age) and 646 dentists (361 males, 285 females; 25 to 80 years of age) were asked to indicate the most and least pleasing smile, and to complete a questionnaire. The data were statistically evaluated using an ANOVA test.
RESULTS: Among laypersons: 838 (65.72 per cent) preferred smile N1; 91 (7.13 per cent) liked smile N2; while 346 (27.13 per cent) chose N3; the differences were statistically significant ($P < 0.05$). No statistical differences were found when gender and age groups were analysed. Among dentists, 481 (74.46 per cent) preferred smile N1; 44 (6.81 per cent) liked smile N2; while 121 (18.73 per cent) chose N3; the differences were statistically significant ($P < 0.05$). No statistical differences were found when gender and age groups were analysed. No statistical differences were observed when the layperson and dentist groups were compared.
CONCLUSION: A full, broad, smile without lateral black corridors was judged to be more aesthetic by dentists and laypersons. Age and gender did not seem to be relevant.

14 DEFORMATION OF SOLDERED, LASER WELDED AND ADHESIVELY BONDED TRANSPALATAL ARCHES

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AIM: To (i) measure the sagittal and vertical deflection of transpalatal arches (TPAs) connected with palatal implants, (ii) determine the deformation of the TPA in the sagittal and vertical direction, (iii) test the deflection behaviour of different wire dimensions, and (iv) evaluate soldering versus laser welding versus adhesive bonding, for each of the TPA-palatal implant systems.
MATERIALS AND METHOD: Six stainless steel wire dimensions were selected: 0.8 × 0.8, 0.9, 1.0, 1.1, 1.2, and 1.2 × 1.2 mm. For each dimension 10 wire specimens were soldered, 10 were laser-welded, and 10 were adhesively bonded to the implant abutment on a plaster cast. Forces of 50, 100, 150, 200, 250 and 300 cN were directed to the TPA in a measuring device by means of an aluminium double leaf spring. The deflections of the TPA were recorded by two laser high linearity optoelectronic sensors (measuring accuracy 1 μ). After having reached 300 cN loading, the TPAs were unloaded in decreasing steps of 50 cN.
RESULTS: A maximum sagittal deflection at 300 cN was found for the 0.9 × 0.9 mm adhesively bonded TPAs (980 ± 61 μ) and a minimum deflection for the 1.2 × 1.2 mm laser welded TPAs (176 ± 19 μ). Maximum permanent deformation occurred in 0.8 × 0.8 mm laser welded TPAs (44 ± 34 μ), minimum permanent deformation for the 1.2 × 1.2 mm soldered TPAs (1 ± 3 μ). Maximum

vertical deflection averaged 201 ± 26 μ for the 0.8 × 0.8 mm adhesively bonded TPAs, and the minimum averaged 18 ± 4 μ in 1.2 × 1.2 mm laser welded TPAs. Maximum permanent deformation occurred in 1.0 × 1.0 mm adhesively bonded TPAs (15 ± 41 μ), and minimum permanent deformation in 1.2 ×1.2 mm soldered TPAs (0 ± 0 μ).
CONCLUSIONS: Absolute orthodontic anchorage without deformation of TPAs was not observed in this study. Wires thicker than 1.2 × 1.2 mm or cast anchorage elements may be considered but may result in greater patient discomfort and higher costs.

15 VOLUMETRIC ANALYSIS OF ROOT RESORPTION IN HUMAN PREMOLARS UNDER CONTROLLED INTRUSIVE ORTHODONTIC FORCES

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AIM: To quantify, three-dimensionally, the amount of root resorption present when different intrusive force magnitudes are applied to human premolars and to establish the sites where root resorption is more prevalent after controlled orthodontic intrusion.
SUBJECTS AND METHOD: Fifty-four right and left maxillary first premolar teeth due to be extracted for orthodontic reasons in 27 patients were intruded for a period of 28 days using buccal and palatal β-titanium molybdenum alloy (TMA) 0.017 × 0.025-inch cantilever springs. The patients were randomly divided into three groups: group 1, heavy (225 g) and control force (0 g) on the contralateral side; group 2, light (25 g) and control force (0 g) on the contralateral side; and group 3, light (25 g) and heavy force (225 g) on the contralateral side. After the experimental period, the teeth were extracted using a strict protocol to avoid root surface damage and analysed using a micro computed tomographic scan X-ray system (Sky Scan-1072, Belgium) and specially designed software for volumetric measurements.
RESULTS: The extent of root resorption measured as the volume of the craters after intrusion was found to be directly proportional to the magnitude of intrusive force applied. The control group had fewer and smaller root resorption craters and the light force group more and larger root resorption craters than the control group. The heavy force group had the most and largest root resorption craters of all groups. The mean volume of the resorption craters in the light and heavy force groups was 2- and 4-fold greater than the control group, respectively. These differences were statistically significant. The mesial and distal surfaces presented the greatest resorption volume with no statistically significant difference between the two surfaces.

16 POST-SURGICAL STABILITY OF BONE PLATE SKELETAL ANCHORAGE**

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AIM: To evaluate different parameters responsible for loosening of mini-plate skeletal anchorage.
MATERIALS AND METHOD: Two hundred and seventy six mini plate bone anchors placed in 186 patients over a period of 4.5 years. All clinical data available from surgeons and orthodontists were analysed. For each patient the influence of surgeon, orthodontist and patient related parameters on implant stability were evaluated.
RESULTS: Fifteen bone anchors were completely exfoliated, all within 8 to 50 days after surgery. Sometimes only a temporary increase in mobility with no local infection was observed. In decreasing order of importance the following factors affected implant mobility: 1. The surgical technique: the incision of the soft tissues, the vertical and sagittal positioning of the bone plate, close implant-bone contact coronally; increased incidence of local infection and mobility when surgery was combined with extractions. 2. Oral hygiene in the proximity of the bone anchor was easier when the section of the coronal part piercing the soft tissues was round. 3. Loading: initial loading should be started no later than 3 weeks after surgery with a maximum of 100 g continuous force, which can be progressively increased after 1 month; the longer the loading the greater

stability; increased mobility due to muscular intermittent and 'jiggling' forces. 4. Type of orthodontic force application: higher failure rates were observed after Class III orthopaedic traction in young patients. No differences in implant stability were observed related to the location of the four implant sites used.
CONCLUSION: The most critical parameters are positioning of the bone plate during surgery, oral hygiene and the timing and type of orthodontic loading. When these parameters are taken into consideration, the failure rate is very low even after long-term loading with heavy forces.

17 CARIES-INHIBITING PREVENTIVE MEASURES USED IN ORTHODONTIC PRACTICES – AN EVIDENCE-BASED DECISION?

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AIM: To survey measures used in Dutch orthodontic practices to prevent decalcification during fixed appliance treatment, and to compare these measures with the outcomes of two recent systematic reviews (Benson *et al*., 2004; Derks *et al*., 2004) concerning prevention of demineralisation during orthodontic treatment.
SUBJECTS AND METHOD: All 229 orthodontists working in the Netherlands, who were affiliated with the Dutch Dental Association, received a questionnaire.
RESULTS: The response rate to the questionnaires was 78 per cent (178 orthodontists). Ninety-one per cent had a basic protocol concerning oral hygiene and prevention of demineralisation at the start of fixed appliance treatment. In 95 per cent of cases this protocol contained oral hygiene instruction. A fluoride mouth rinse was prescribed by 51.6 per cent of the orthodontists. Fluoride gel or varnish and chlorhexidine rinse or varnish was rarely prescribed. In the case of development of white spots, 99 per cent of the orthodontists took extra measures. If the standard measures as applied in Dutch orthodontic practices are compared with the outcome of the systematic reviews, there are some interesting differences. The additional use of chlorhexidine or toothpaste with a high fluoride concentration, as demonstrated to inhibit demineralisation (Derks *et al*., 2004), is rarely prescribed. A fluoride rinse with a low fluoride concentration was prescribed most often, although there is no high quality, long-term study that demonstrates a caries preventive effect in orthodontic patients (Benson *et al*., 2004; Derks *et al*., 2004). It was considered by 67.6 per cent of the orthodontists to be necessary to develop a practice guideline to prevent demineralisation.
CONCLUSIONS: Orthodontists do not implement the best available evidence in their practice to prevent white spots during fixed appliance treatment. It is recommended that an evidence-based practice guideline for prevention of enamel decalcification should be developed.

18 UPPER INCISOR INCLINATION AND LIP LINE: AN ORTHODONTIC RELATIONSHIP?

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AIM: To investigate if any correlation could be found between lip line height and incisor inclination in a group of randomly selected patients; to evaluate changes in incisor inclination after orthodontic treatment in Class II division 2 patients and the long-term stability after retention (upper lingual retainer or Hawley type retainer); and to test the relationship between long-term stability of incisor inclination in Class II division 2 patients and lip line height.
MATERIALS AND METHOD: In the first part of the study, measurements were made on cephalograms of 200 randomly selected patients. All had competent lips at rest and had not undergone orthodontic treatment or extractions. In the second part of the study dental casts and cephalograms of 61 Class II division 2 patients with competent lips were studied before, at the end, and a mean of 3.5 years after treatment. A measuring procedure was developed to determine upper incisor inclination on dental casts. The cephalograms were used to define lip line height.
RESULTS: Incisor inclination was correlated with lip line height. Incisor inclination changed on

average 15.2 degrees during treatment. A mean relapse of 2.2 degrees was observed 3.5 years post-treatment. The amount of relapse was independent of the retention appliance used. A decrease in lip line height of 0.6 mm was seen at the end of treatment.
CONCLUSIONS: A higher lip line is associated with more retroclined incisors. Proclination or torque of upper central incisors in Class II division 2 subjects appears to be stable. The type of retention appliance is not important for the long-term result. Although the observed changes in lip line height during and after treatment were statistically significant, they were too small to draw clinically relevant conclusions.

19 PAIN DISCOMFORT AND CREVICULAR FLUID CHANGES INDUCED BY ORTHODONTIC ELASTIC SEPARATORS IN CHILDREN

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AIM: To study pain after placement of orthodontic elastic separators and the possible associations with gingival crevicular fluid (GCF) composition changes at the level of interleukin-1beta (IL-1β), substance P (SP) and prostaglandin E_2 (PGE_2).
SUBJECTS AND METHOD: Eighteen children (mean age 10.8 years) at the beginning of orthodontic treatment. Molar elastic separators were inserted mesially between two first upper or lower molars. One of the antagonist molars served as the control. GCF was collected from the distobuccal and distopalatal sites from each molar 7 days before, on the day of placement, and after placement of the separators (1 hour, day 1 and day 7). Pain intensity was recorded using a visual analogue scale (VAS). The contents of IL-1β, SP and PGE_2 were determined by ELISA.
RESULTS: Pain intensity increased after 1 hour (VAS = 11) and remained high on day 1 (VAS = 13). On day 7, no significant pain was reported. After 1 hour, 1 day and 7 days, the mean GCF IL-1β levels were significantly elevated in the treated teeth compared with the control teeth (highest at day 1). The GCF levels of SP and PGE_2 for the treated teeth were significantly higher at day 1 and day 7 than for the control teeth. All three mediators in the control remained at baseline levels throughout the experiment. The intensity of pain at 1 hour was associated with PGE_2 levels. At day 1 the three mediators as a group were related to the intensity of pain, but none alone could be identified as playing the principal role in this association.
CONCLUSIONS: Crevicular fluid analysis revealed a rapid release of biochemical mediators (1 hour) that peaked after one day and partially decreased seven days later. The intensity of pain followed a similar pattern. There is an association between initial intensity of pain (1 hour) and PGE_2 levels.

20 TWO RAPID CANINE RETRACTION TECHNIQUES

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AIM: To assess and compare two rapid canine retraction modalities: alveolar bone distraction (ABD) versus periodontal membrane distraction (PMD), with regard to the rate of retraction, nature of tooth movement (tipping versus translation), and anchorage loss in the posterior segment.
SUBJECTS AND METHOD: In nine adolescent patients (5 females, 4 males) with an initial mean age of 17.8 years, rapid retraction of maxillary canines was carried out with custom-made, tooth-borne, intra-oral, unidirectional distraction devices. In each patient the canine on one side was retracted by ABD and the other by PMD. Appliances were inserted immediately after surgery and activated 0.5 mm a day. The nature of tooth movement, anchorage loss, root resorption, dental pulp vitality, bone formation and periodontal health were evaluated.
RESULTS: The nature of tooth movement was a combination of translation and distal crown tipping in both groups; however, the extent of tipping was greater in the PMD group. Anchorage loss in the posterior segment was seen with both techniques. There was minimum extrusion of the

canines and molars with no significant difference between the two groups. Root resorption was observed with both modalities. In both groups, canine sensitivity decreased. Comparison of the two groups showed non-significant results with regard to pocket depth, attachment level and crestal bone height; there were only significant differences in pocket depth affecting the lateral incisor. There was no difference between the two groups in distraction time (21.7 days at the ABD side and 24.6 days at the PMD side).
CONCLUSION: For rapid retraction of canines both techniques were effective, with ABD being slightly more efficient.

21 ZYGOMATIC ANCHORAGE SUPPORTED MOLAR DISTALIZATION

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AIM: To evaluate molar distalization with zygomatic anchorage support.
SUBJECTS AND METHOD: Eight female patients, whose ages ranged from 15 to 27 years, average 18 years. Six had a Class II skeletal relationship and two a Class I skeletal relationship. In all subjects, molar distalization was the treatment of choice to resolve anterior crowding and to correct the sagittal relationship. Multipurpose implants were adjusted to fit the zygomatic buttress area and round bar extensions were exposed into the oral cavity at the border of the attached and mobile gingiva. Round bar extensions were bent in a mesial direction. The maxillary first molars were banded and brackets were placed on the canines. A NiTi open coil spring and, mesial to that, a round sliding tube, were inserted on a rectangular segmental stainless steel archwire placed between the molar and canine. The round tube on the archwire was attached to a sliding lock via a soldered vertical round wire. The sliding lock was inserted on the round bar extension of the multipurpose implant. Activation was achieved by shifting the sliding lock in a distal direction, thus compressing the NiTi open coil spring.
RESULTS: No implant failure occurred during treatment. The amount of molar distalization was between 2 and 7 mm (average 5.5 mm). The amount of molar tipping ranged between 5 and 18 degrees (average 12.5 degrees). The amount of distobuccal rotation was between 12 and 33 degrees (average 19.5 degrees). No change in the anterior teeth was observed during molar distalization and distalization was completed in 5-7 months.
CONCLUSION: Zygomatic anchorage supported molar distalization is a practical and effective procedure.

22 NICKEL SENSITISATION FOLLOWING EXPOSURE TO ORTHODONTIC APPLIANCES AND PIERCING

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AIM: Based on data from a cross-sectional study of a Swedish adolescent population, the association between nickel sensitisation and exposure to different orthodontic appliances and/or piercing was investigated. Additional risk factors such as gender, atopy, diet, cigarette smoking and age at the time of piercing were explored.
SUBJECTS AND METHOD: A total of 4376 adolescents (mean age 17.3 years; range 14.0-2.1 years) were patch tested for contact allergy (True test®, panels 1 and 2) and questioned about earlier piercing and orthodontic treatment. Information on exposure to an orthodontic appliance was verified from dental records. Exposure to orthodontic appliances was collected as time of onset, duration, and type of appliance. Adjusted odds ratios (OR) were calculated and the effects of a number of variables on the probability of having nickel hypersensitivity were evaluated using multivariate logistic regression analysis. The analysis was based on 1133 subjects.
RESULTS: Questionnaire data on age at piercing and exposure to any orthodontic appliance demonstrated a reduction in nickel sensitisation when orthodontic treatment preceded piercing (OR = 0.48; CI = 0.29–0.82). Calculations for exposure according to dental records demonstrated

similar results, but the statistical significance was lost when adjusting for confounding factors (smoking, age at piercing).
CONCLUSIONS: The results support earlier studies that indicate a reduced risk for nickel hypersensitivity following orthodontic treatment. Orthodontic appliance treatment preceding piercing reduces the risk of nickel hypersensitivity by a factor of 1.5–2. Furthermore, the risk reduction appears to increase with the length of treatment. Smoking and age at piercing are important risk factors to consider.

23 COMPARISON OF THE INITIAL ORTHODONTIC FORCE SYSTEMS PRODUCED BY TWO LINGUAL BRACKET SYSTEMS AND A LABIAL STRAIGHTWIRE APPLIANCE

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AIM: In recent years, lingual appliances have been established as an alternative orthodontic treatment technique. Many studies have concentrated on various aesthetic aspects, laboratory and clinical procedures as well as on patient comfort and compliance. The orthodontic force systems, however, have not yet been investigated. The purpose of this study was to determine and compare the forces and moments produced by a new individualized lingual appliance, a standard lingual appliance, and a labial straightwire appliance, in the initial phase of orthodontic treatment.
MATERIALS AND METHOD: The dentition of 10 orthodontically treated patients was replicated into measurement casts that were fitted with lingual as well as labial brackets. Special care was taken to precisely reproduce the inter-bracket geometry of each patient. The force systems generated by a levelling arch inserted into the lingual and labial brackets were measured for each tooth using an industrial robot and a three-dimensional force-moment sensor.
RESULTS: The force systems of the new lingual and labial appliances were found to be similar with regard to the magnitude of the majority of force and moment components. Significant differences were found only for certain teeth and single components of the force systems. However, the force systems of the standard lingual appliance were generally larger than those produced by the other appliances.
CONCLUSIONS: The initial force systems produced by the new lingual appliance proved to be comparable with those delivered by a straightwire appliance. The actual levels of forces and moments, however, have to be regarded as too large, especially using a standard lingual appliance. The development of levelling wires producing smaller forces and moments is thus recommended.

24 EXPERIENCES WITH ALVEOLAR DISTRACTION

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AIM: Alveolar ridge height deficiency is one of the most common problems arising in oral rehabilitation with dental implants. If uncorrected, ridge height deficiency requires the use of short implants with long crowns, and may even preclude implants altogether. Various techniques have been used to resolve this problem, including autologous bone grafting, bone regeneration with biomaterials, and alveolar distraction. This latter technique, introduced relatively recently, has advantages, including low morbidity (particularly since there is no need for additional surgery to obtain grafting material), a low risk of bone resorption, and a short delay (only 12 weeks) between surgery and implant placement.
MATERIALS AND METHOD: A total of 30 alveolar distraction procedures were performed in 22 patients, using intraosseous distractors (Lead System, 23 distractions) or juxtaosseous distractors (Modus System, 7 distractions). Subsequently 1, 2, 3 or 4 implants were placed in each distracted area, giving a total of 68 implants (58 ITI, 9 Frialoc, 1 Frialit). Finally, prostheses were fitted to the implants, with subsequent follow-up for up to 1 year.
RESULTS: The mean ridge height gain was 6.31 ± 1.64 mm ($P < 0.05$), allowing placement of

implants with lengths between 8 and 13 mm. At the 1 year follow-up evaluation there was a mean ridge height loss of 0.64 mm around each implant.
CONCLUSIONS: Alveolar distraction is an effective procedure for alveolar ridge regeneration. It permits the placement of implants ensuring a favourable relationship between implant length and crown height. The rate of bone loss around implants placed in distracted areas was similar to that seen around implants placed without previous bone regeneration.

25 VIRTUAL INDIRECT BONDING: A NEW TOOL IN DIGITAL ORTHODONTICS

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AIM: To present a virtual indirect bonding procedure to be used in daily practice, in the treatment of malocclusions in the permanent dentition using straightwire brackets.
MATERIALS AND METHOD: The procedure starts with digital models made through a silicone impression, a wax bite and selected straightwire brackets. The prescription form is then completed by the clinician and a virtual occlusal set-up in three dimensions is produced from this prescription. A laboratory developed direct method allows transfer of the brackets from the final virtual occlusal set-up to the initial stone model, based on a military style pattern recognition algorithm to ensure precise bonding. A final procedure to fabricate the dual trays then follows
RESULTS AND CONCLUSION: The precise brackets position obtained with the direct method, in the laboratory, on the initial stone model from the virtual occlusal set-up expresses the full potential of the straightwire appliance with better outcomes in a shorter treatment time. Chair time is reduced by using bonding procedures with accurate trays.

26 TREATMENT CHANGES IN BORDERLINE CASES: EXTRACTION VERSUS NON-EXTRACTION WITH THE AIR-ROTOR STRIPPING TECHNIQUE

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AIM: A prospective randomized study was designed to compare the skeletal, dental and soft tissue profile changes in borderline cases treated either with or without extractions but utilising the air rotor stripping (ARS) technique.
SUBJECTS AND METHOD: Twenty-six borderline subjects, who could have been treated either with or without extractions, were randomly divided into two groups. In the first group, 13 patients, (mean age 18.1 ± 3.7 years), were treated with extraction of four premolars. In the second group, 13 subjects (mean age 17.8 ± 2.4 years), crowding was resolved by ARS in combination with an anterior Essix plate. Lateral cephalometric radiographs and dental models taken before and after treatment were evaluated.
RESULTS: The initial skeletal, dental and profile characteristics of both groups were similar. In the first group, retraction of the upper and lower incisors was observed. In the non-extraction group, the inclination of the maxillary and mandibular incisors, the position of the upper lip, the maxillary and the mandibular sulcus contours and depths were unchanged by treatment. The nasolabial angle was found to be slightly decreased and lower lip to subnasale-pogonion distance to be increased. The main soft tissue profile differences between the two groups were a slightly more retruded upper and lower lip and a more pronounced mandibular sulcus depth in subjects with extractions. The treatment time in the non-extraction group was significantly decreased.
CONCLUSION: In subjects with an Angle Class I malocclusion and moderate crowding, both extraction and non-extraction ARS therapy resulted in well-balanced facial aesthetics. However, the reduced treatment time of non-extraction ARS treatment could be taken into consideration when deciding whether or not to extract.

27 RELATIONSHIPS BETWEEN MALOCCLUSIONS AND PERIODONTAL ATTACHMENT LOSS OR INCREASED POCKET DEPTH IN ADULTS

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AIM: To determine associations between different types of malocclusions and periodontal disease, including attachment loss (AL) and increased pocket depth (PD).
SUBJECTS AND METHOD: The Study of Health in Pomerania is one of the largest population-based studies in Europe, combining medical and dental examinations. A randomly selected sample of 7008 adults aged 20-81 years were invited to participate and 4310 were examined (response rate 68.8 per cent). In 698 males and 796 females, aged 20-49 years and who had at least 15 teeth, associations between malocclusion and AL and PD were analysed. Various occlusal traits such as crowding, edge-to-edge bite, crossbite, open bite, deep bite, overjet, negative overjet and retroclined maxillary incisors were investigated, and they were then adjusted for gender, age, diabetes, smoking, education and plaque. Backward step logistic regression was used with the upper quartiles of the average attachment loss and the average increased pocket depth as the dependent variables. The attributable risk was calculated.
RESULTS: Increased overjet showed a significant association with AL and PD. Moreover a dose-effect relationship was found: for AL in the anterior segment (from canine to canine) the odds ratio (OR) for an increased overjet of 4-6 mm was 1.5, and for an overjet >6 mm it was 3.1. For PD the OR for an increased overjet of 4-6 mm was 1.4 and for an overjet > 6 mm it was 2.3. Calculation of the attributable risk showed that more than 15 per cent of the periodontal disease cases were associated with an increased overjet.
CONCLUSIONS: The strength of the associations (OR) and the dose-effect relationship indicate a relationship between increased overjet and AL or increased PD, respectively.

28 COLLAGEN FIBRES ARE CRUCIAL FOR THE BIOMECHANICS OF THE PERIODONTAL LIGAMENT

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AIM: The periodontal ligament (PDL) is a soft connective tissue consisting of a fluid phase (interstitial fluid) and a solid phase (collagen fibres). The fluid phase is designed to have a dampening effect, whereas the collagen fibres restrain the movements of the teeth. A finite element model (FEM) that implements both physical characteristics is still lacking. Recently, such a poroviscoelastic fibre-reinforced model was developed for cartilage. Although cartilage and PDL are different types of connective tissue and have different fibre architecture, they both contain a network of collagen fibres. The aim of this study was to explore the use of the poroviscoelastic fibre-reinforced cartilage model as a model for the PDL.
MATERIALS AND METHOD: A three-dimensional FEM was constructed of the PDL and its surrounding bone. The paraboloid shaped PDL was considered to be poroviscoelastic fibre-reinforced with non-linear viscoelastic fibres. The model allowed calculation of the stress and strain within fibres. Two different fibre orientations were used: horizontal fibres, and a physiological orientation based on histological observations. Forces of 1 N were applied in a lateral direction. The fluid was free to flow at the top of the PDL and at the outer boundaries of the bone.
RESULTS: The model with horizontal fibres showed a gradual deformation of the PDL, followed by a slowly decreasing viscoelastic response. In the physiological model, the fibres stretched more rapidly in the cervical and apical regions, resulting in faster movement. As expected, the fibre stress in the first model was more homogenously distributed along the root than in the physiological model.
CONCLUSIONS: The poroviscoelastic fibre-reinforced material model shows promise in the investigation of the mechanical behaviour of the PDL. Orientation of the collagen fibres appears to be crucial for the biomechanics of the PDL.

29 CORRELATION OF SPONTANEOUS MASTICATORY MUSCLE ACTIVITY IN RABBITS

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AIM: To characterize the activity patterns of four masticatory muscles in rabbits, and to examine the intermuscular correlation in normal daily activity.
MATERIALS AND METHOD: A fully implantable four-channel radio-telemetry device was employed to record the electromyograms of the anterior superficial and posterior deep masseter, the medial pterygoid, and the digastric muscle in six adult male New Zealand White rabbits. Muscle use was characterized by determination of the relative time in an hour (duty time) that it exceeded specified levels (2, 5, 10, 20, 50 and 90 per cent) of the peak activity. The individual intermuscular relationship in muscle use was estimated by calculation of Pearson's correlation of hourly duty times for the six different muscle pairs and for the various activity levels over a period of 24 hours.
RESULTS: Hourly duty times exhibited day-to-day variations at all activity levels. These findings suggest an apparent, but individually different, circadian pattern of masticatory muscle use. Jaw muscle activity was highly correlated within all animals. Activity in pairs of jaw-closing muscles was more highly correlated ($r = 0.699$ to 0.836) than in muscle pairs including the jaw-opening digastric muscle ($r = 0.489$ to 0.590). For muscle pairs including the digastric, this correlation decreased continuously with increasing activity. Jaw-closing muscle pairs showed a comparable effect, but the correlation was highest for muscle activities exceeding the 10 per cent level. The highest mean correlation was found for the combination of the two masseter regions, the lowest in the pair consisting of the medial pterygoid and digastric muscles.
CONCLUSIONS: Correlation of hourly activity of jaw-closing and jaw-opening muscles exhibits noticeable differences, indicating differential control of these muscle groups. Masticatory muscle activation might also be independently controlled during low and high power motor behaviour.

30 A STUDY OF ROOT RESORPTION AFTER VERTICAL TOOTH MOVEMENT

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AIM: To compare root resorption in the same individual after application of continuous intrusive and extrusive forces.
SUBJECTS AND METHOD: In nine patients (mean age 15.3 years), both maxillary first premolars were randomly intruded or extruded with a continuous force of 100 cN for eight weeks. Eleven maxillary first premolars from six randomly selected orthodontic patients were used as controls. Quantitative assessment of the resorbed area of the root surface was performed on composite scanning electron micrographs.
RESULTS: Root resorption occurred mainly in the apical portion of the roots in both experimental groups. The extent of root resorption in the intruded teeth (5.78 ± 3.86 per cent) was significantly higher than in the extruded teeth (1.28 ± 1.24 per cent of the total root surface, $P = 0.004$) and in the controls ($P = 0.006$). No difference was found between the extruded and control teeth. In addition, large individual variation was found. The extent of root resorption after intrusion and extrusion within the same patient was highly correlated.
CONCLUSIONS: Intrusion of teeth causes almost four times more root resorption than extrusion. As the amount of root resorption due to intrusion or extrusion in the same patient is correlated, clinicians should be aware that extrusion of the teeth might also cause root resorption in susceptible patients.

31 BONE BORNE RAPID PALATAL EXPANSION – A MINIMAL INVASIVE TECHNIQUE

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AIM: Rapid palatal expansion (RPE) is indicated in the management of severe transverse maxillary deficiency. Its primary goal is to maximize orthopaedic and minimize orthodontic movements. Fixation of the appliance to the crowns of the teeth leads to a greater degree of tipping and, additionally, resorption of the roots and the buccal cortical bone may be observed. The aim of the present study was to improve bodily movement and prevent root resorption and bone fenestration.
SUBJECTS AND METHOD: In 10 patients undergoing orthognathic surgery and 10 controls, the new method of RPE, employing direct fixation of the hyrax screw, was implemented. One short extraoral implant with a supraperiostal step (EO ID 4.0 mm – Ti, Straumann; length 4 mm and diameter 3.5/5.0 mm), and one screw with an onplant were used on both sides for fixation. The screw was activated three to four times per day. Expansion was additionally guided by separated orthodontic wires.
RESULTS: Expansion of 7 to 12 mm was achieved in 10 days and the hyrax screw was removed after 12 weeks. In comparison with 10 tooth-borne hyrax screws, tipping of the palatal halves was 7.5 degrees less with the use of bone-borne hyrax screws. The implant continued to be used for fixation of the palatal bar to prevent transverse relapse.
CONCLUSIONS: The new method is minimally invasive and protects the roots and the alveolar bone from resorption.

32 A COMPUTER TOMOGRAPHIC BASED MORPHOMETRIC INVESTIGATION OF HEMI-MANDIBULAR HYPERPLASIA USING MODERN DIGITAL ANALYSIS

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AIM: To quantitatively evaluate the unilateral skeletal malformation characteristics of hemi-mandibular hyperplasia caused by pathological growth, and to quantify differences in masseter muscle dimensions of the affected and non-affected sides.
MATERIAL AND METHOD: Computed tomographic data records of five patients aged between 18 and 25 years were analyzed. Data analysis was carried out using VoXim® reconstruction software, which permits three-dimensional measurements based on modern visualization algorithms. The software, InSpace®, based on volume-rendering technology, was also utilised. The following parameters were measured by comparing the values of the affected and unaffected sides of the mandible: volume and spongiodensity of the temporomandibular joints (TMJ), ramus height and mandibular corpus length, maximum diameter of the condyles and total mandibular length. Maximum length, and transverse and sagittal measurements of the masseter muscle were investigated at the level of the occlusal plane.
RESULTS: The average volume of the condyles on the affected side of the mandible was calculated at 3.4 ml, showing an average enlargement of 1.97. On the side of pathological growth, the average ramus height was 11 mm greater than the normal ramus dimension on the opposite side, whilst corpus length was only slightly greater on the affected side. The masseter muscle was, on average, 9 mm longer on the affected side but maximum sagittal and transverse measurements demonstrated only minor unilateral changes.
CONCLUSIONS: The TMJ and ramus were most obviously affected by the unilateral pathological growth pattern. However, the large standard deviations are attributed to individual morphology in each case, and this is very difficult to predict individually. The masseter muscle showed a compensatory elongation as a result of soft tissue reaction to the unilateral skeletal mandibular enlargement.

33 EXTRA- VERSUS INTRA-ORAL APPLIANCES FOR DISTAL MOVEMENT OF MAXILLARY FIRST MOLARS: A RANDOMIZED CONTROLLED TRIAL

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AIM: To evaluate and compare the treatment effects of an extraoral (EOA) and an intraoral (IOA) appliance for distal movement of the maxillary first molars.
SUBJECTS AND METHOD: After undertaking a sample size calculation, a total of 40 patients (mean 11.5 years, SD 1.29 years) undergoing non-extraction treatment to correct a Class II molar relationship were randomized to one of two groups: either EOA (cervical headgear) or OIA using superelastic coils for distal movement of maxillary first molars. The outcome measures assessed in the trial were treatment time, cephalometric analysis of distal molar movement, anterior movement of maxillary central incisors (i.e. anchorage loss) and changes in the sagittal and vertical skeletal position of the maxilla and mandible.
RESULTS: In the IOA group the molars were distalized during an average time of 5.2 months while in the EOA group the corresponding time was 6.4 months ($P < 0.01$). The mean amount of distal molar movement was significantly greater in the IOA than in the EOA group, 3.0 mm versus 1.7 mm ($P < 0.001$). Moderate anchorage loss was found with the IOA and this was associated with an increased overjet (0.9 mm), while the EOA resulted in a decreased overjet (0.9 mm).
CONCLUSIONS: The IOA was more effective than the EOA for distal movement of the maxillary first molars.

34 REIMPLANTATION OF TEETH AND REVASCULARIZATION

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AIM: In a previous pilot investigation, ingrowth of pulpal tissue in implanted empty catheter tubes with a foramen less than 1 mm was studied. The findings of that study suggested that ingrowth of new tissue was possible even through very small foramina. This hypothesis was tested more extensively in an animal study: Is there a need for a minimal diameter of the apical foramen to allow revascularisation after transplantation?
MATERIALS AND METHOD: In three beagle dogs, 10 monoradicular teeth (6 incisors, and 4 premolars) were extracted, apicectomised and then reimplanted. In an attempt to measure the size of the apical foramen, the apices were photographed. The pulp tissue from five teeth was removed from the apical side before reimplantation. After 14 weeks the dogs were sacrificed and histological sections made.
RESULTS: Revascularisation was more successful for first premolars than for the incisors, although the apical foramen was smaller in the first premolars. The oval foramen of the premolars had a maximal diameter varying between 0.24 and 0.64 mm. Fourteen teeth showed ingrowth of new tissue to at least half or more of the pulp chamber. For these teeth the maximal diameter of the oval foramen was 0.24 to 1.13 mm.
CONCLUSION: An apical foramen of at least 1 mm, as suggested by Andreasen *et al*. (1990), does not seem to be the determining factor for success of ingrowth of new pulpal tissue. Since two of the very successful teeth had apical foramina of only 0.34 and 0.42 mm, there must be factors other than the diameter of the apical foramen influencing the ingrowth potential of new pulpal tissue. This study seems to confirm the results of the initial pilot study on implanted catheters.

35 A THREE-DIMENSIONAL ANALYSIS OF FACIAL GROWTH IN A COHORT OF CHILDREN

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AIM: To evaluate three-dimensional (3D) changes occurring in facial growth in a cohort of children.
SUBJECTS AND METHOD: Seventy-one children (41 males and 30 females; initial mean age 11.8 years) with normal facial proportions were studied longitudinally for 12 months. Laser scanned images were obtained under a reproducible and controlled environment with two Minolta Vivid 900 laser scanning devices. Each of the children had a set of 3D scans taken at 6 monthly

intervals. Eight hundred and fifty two left and right facial scans were collected and pre-processed, thus generating 213 merged facial scans over three time intervals (baseline, six months, and 1 year). For each child, the three scans were overlaid onto one another using the iterative closest point algorithm and the growth changes recorded as mean changes. The nasal prominence, lips and chin points were recorded and paired *t*-tests, were used to compare the mean changes that occurred.
RESULTS: Thirty-five per cent of the females and 50 per cent of the males exhibited facial growth in the 1-year period. The changes in magnitude, measured across the three areas, were statistically significant in the male group as compared with the female group ($P < 0.05$). Furthermore, asymmetric or 'shuffling' growth was seen in 35 per cent of the cohort.

36 ASYMMETRIES IN THE FRONTAL PLANE – AN ORTHODONTIC AND ORTHOPAEDIC EVALUATION

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AIM: Clinical studies on asymmetries have revealed a high level of asymmetry in craniofacial or temporomandibular structures and muscular function. The present study was conducted to evaluate possible relationships between orthopaedic and orthodontic findings in the frontal plane.
SUBJECTS AND METHOD: Two hundred and forty consecutive patients (163 males and 77 females, mean age 6.87 years ± 2.34 years) who had been referred to the Centre of Manual Medicine for Children by orthopaedic surgeons or paediatricians due to suspected asymmetry of the upper cervical spine and/or trunk were recruited for this study. Each patient had undergone an orthopaedic and radiological examination with evidence of an asymmetry in the upper cervical spine. The following orthopaedic aspects were investigated: oblique shoulder and pelvis, functional leg length difference, weakness of the medial arch. In addition, a dental examination was undertaken and midline shifts > 2 mm were recorded.
RESULTS: Differences between children with and without a midline shift were recorded, with an increased incidence of special orthopaedic parameters in the frontal plane being observed in children with midline discrepancies. An asymmetric occlusion was not necessarily combined with a pathological orthopaedic variable, but children with a dental midline shift showed an oblique shoulder ($P = 0.041$), an oblique pelvis ($P = 0.05$) and a functional leg shortness ($P = 0.012$) statistically more often than those with no dental asymmetry.
CONCLUSIONS: Dental and jaw asymmetries appear to be correlated with orthopaedic asymmetries in the frontal plane. Early orthopaedic screening should be performed in children with a severe midline shift, in order to detect asymmetric development.

37 EFFECTS OF RAPID CANINE RETRACTION USING DENTOALVEOLAR DISTRACTION OSTEOGENESIS

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AIM: Patients frequently complain about the duration of orthodontic treatment time and the use of extraoral anchorage appliances. To overcome this, rapid canine retraction using the principles of dentoalveolar distraction osteogenesis (DAD) was used and the effects of rapid and conventional canine movement compared.
SUBJECTS AND METHOD: The subjects comprised a DAD group consisting of 36 maxillary canines in 19 subjects (mean age 15.8 years) and 27 maxillary canines in 14 subjects (mean age 16.0 years). The canines in the DAD group were moved rapidly into the sockets of the extracted first premolars following minor surgery. A custom-made, intraoral, rigid tooth-borne distraction device was used and activated at a rate of 0.8 mm/day, while elastic traction was used in the conventional treatment subjects. The rate of newly formed alveolar bone was assessed using a step wedge technique in the distraction region.

RESULTS: The mean canine retraction was 7.21 mm in 11.8 days (10-14 days) in the DAD group, while 4 mm retraction was achieved in 5.6 months in the conventional group ($P < 0.01$). The anchorage teeth were able to withstand the retraction forces with minimal sagittal or vertical anchorage loss in the DAD group, compared with the conventional treatment group ($P < 0.01$). No clinical or radiographic evidence of complications such as root fracture, root resorption, ankylosis or soft tissue dehiscence were observed in the DAD subjects. The density of newly formed alveolar bone reached 82.5 per cent of its initial value by the sixth month.
CONCLUSION: The DAD technique is an innovative method, since it reduces the duration of orthodontic treatment considerably in extraction cases, without any unfavourable effects in the surrounding structures.

38 EFFECTS OF THE TWIN BLOCK AND DYNAMAX APPLIANCES ON THE SOFT TISSUES

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AIM: 1) To quantify the treatment and immediate post-treatment soft tissues changes following treatment with a Twin Block (TB) or Bass Dynamax (BD) appliance using the techniques of three-dimensional (3D) optical surface laser scanning and cephalometrics and 2) To compare the techniques of 3D optical surface laser scanning and cephalometry in the production of accurate and reliable results.
SUBJECTS AND METHOD: Sixty-two patients and 14 untreated control subjects were recruited. The patients wore the appliances full-time for 9-months and this was followed by 3-months post-treatment observation with no appliance wear. All subjects had optical surface laser scans taken at 3 monthly intervals and lateral cephalograms at the start (0 month) and end (12 month) of treatment. The final records were taken at the end of the post-treatment observation. Statistical analysis was performed using Wilcoxon matched pairs signed rank and Mann-Whitney '*U*' tests.
RESULTS: Both cephalometric and laser scanning results demonstrated a greater increase in lower anterior face height (1.47 mm by cephalometry and 2.48 mm with laser scanning) together with a greater increase in lower lip length in the TB group. The median post-treatment relapse of soft tissue pogonion was –0.7 mm in the TB group and 0.65 mm in the BD group.
CONCLUSIONS: 1) The TB appliance produced greater increases in soft tissue anterior vertical dimensions and lower lip lengths compared with the BD; 2) Both appliances produced the greatest rate of change during the first six months of treatment, with comparable amounts of post-treatment relapse levels; 3) The optical surface laser scanning 'mark and measure' system appears to be a valid method of quantifying soft tissue changes.

39 ARTIFICIAL INTELLIGENCE: A NEW APPROACH TO CEPHALOMETRIC DIAGNOSIS

J Lavergne, N Gasson, Private Practice, Schiltigheim, France

AIM: To use artificial intelligence software to test the possibilities of facial growth regulation.
MATERIALS AND METHOD: An optimal facial growth regulation was taught to neural network software using 190 cephalograms of individuals with ideal occlusion. The results were then applied to 1000 randomly selected cephalograms of patients, most with a basal discrepancy. The idea was to compare two samples: one including the optimal facial growth regulation, as proposed by the software, the other the 'real sample'. The two samples were analysed and classified according to the classification of Lavergne and Petrovic.
RESULTS: Almost 50 per cent of the subjects appeared to be too retrognathic, with 1 in 10 being too prognathic. In almost two-thirds of the patients, the neural network found a solution to achieve a neutral anteroposterior relationship. In comparison, the neutral basal sagittal relationship corresponded to less than half of the subjects in the real sample. The system found no solutions for

the subjects classified as presenting an insufficiency of the regulating mechanism. In the proposed sample only 2 per cent of the individuals were recorded as presenting an error of regulation as opposed to 21 per cent in the real sample. In the same way, the number of patients with a proposed open bite was far lower than the number with an open bite.
CONCLUSIONS: Some groups cannot be managed by the artificial regulation system. This seems to demonstrate that many patients present problems of facial growth regulation, and early interceptive treatment may prove useful.

40 AUTOMATIC LANDMARKING OF CEPHALOGRAMS BY CELLULAR NEURAL NETWORKS AND ALGORITHMS

R Leonardi, D Giordano, M Caltabiano, University of Catania, Italy

AIM: High speed and accuracy in the detection, evaluation and description of cephalometric landmarks is widely demanded. A prototype system, based on cellular neural networks (CNNs) and on specific algorithms, is proposed as an efficient technique for detection of landmarks. This system uses different types of CNNs on the scanned cephalogram: first to pre-process the image and eliminate noise, then to proceed with a sequence of steps in which identification of the co-ordinate points is carried for each point, by appropriate CNN templates, followed by the application of an appropriate edge-following algorithm.
MATERIALS AND METHOD: Twelve landmarks were chosen for preliminary assessment of the prototype on 70 randomly selected pre-treatment cephalograms. Assessment was carried out in two stages. The first stage assessed the image output of the CNNs, to verify that it included and correctly highlighted the sought landmark, and the second stage evaluated performance of the developed algorithms on six landmarks.
RESULTS: On average, 70 per cent of the detected landmarks were located with an error less than 1mm, 20 per cent with 1 to 1.5 mm error, and 10 per cent with 1.5 to 2 mm error. The best detection performances were for pogonion and menton.
CONCLUSION: The precision obtainable with this system is high for certain cephalometric points. The overall success rate can be improved by developing suitable algorithms that take into account morphological variations. These findings are particularly promising if compared with the precision obtained with the other automated landmarking methods described in the literature. Moreover, this CNN based system is also of interest for automatic landmarking, because the method can either be implemented via a software program, or directly embedded in the hardware, when time is critical.

41 A PROSPECTIVE COMPARISON OF THE EFFECTS OF THE TWIN BLOCK AND DYNAMAX APPLIANCES ON THE SKELETAL AND DENTAL TISSUES

G J Mack, R T Lee, The Royal London Hospital, England

AIM: The reported effects of the Twin Block (TB) include a tendency for vertical face height to increase and the lower incisors to procline during treatment. These effects are not always desirable. The aim of this study was to compare the skeletal and dental effects of the TB and Dynamax appliances. The TB was constructed with one large single step advancement and the Dynamax was incrementally advanced.
SUBJECTS AND METHOD: Sixty-two patients were enrolled into a prospective randomised clinical trial. The appliance groups were matched for age and gender. Active treatment lasted 9 months, irrespective of overjet reduction, and final cephalometric records were taken at 12 months. Treatment progress was monitored by clinical measurement of overjet and reverse overjet and patient growth was assessed by the measurement of standing height. Treatment changes were quantified cephalometrically.
RESULTS: Both groups were tested for pre-treatment equivalence. The TB appliance proved to be slightly more effective at advancing the mandible as shown by the statistically significant

differences in ANB reduction (median change TB = –2.0 degrees, Dynamax = –1.1 degrees; *P* = 0.02) and the increase in mandibular unit length (Median change Art-Pog; TB = 4.8 mm, Dynamx = 2.7 mm; *P* = 0.01). The differences in unit length suggest the effects the appliances have on vertical face height. There were, however, no significant differences in dental changes between the treatment groups (Median overjet change; TB =-6 mm, Dynamax = -5 mm. Median lower incisor inclination; TB = 2.1 degrees, Dynamax = 2.8 degrees).
CONCLUSIONS: The TB was slightly more effective in producing favourable skeletal changes and a tendency to increase the vertical facial dimensions to a greater extent than the Dynamax was suggested. The dental changes were similar in both appliance groups.

42 THREE-DIMENSIONAL RADIOGRAPHIC ANALYSIS IN ORTHODONTICS
J Mah, University of Southern California, USA
KEYNOTE ADDRESS

Cone-beam computed tomography (CBCT) is one of the most revolutionary developments in recent dentistry. This presentation will review the fundamentals of CBCT and describe how it may be used in orthodontics. A three dimensional (3D) radiographic analysis of CBCT data for orthodontics will be presented along with clinical illustrations. The analysis includes lateral and frontal cephalometry, facial evaluation, review of osseous morphology, 3D review of the dentition, arch to arch analysis as well as arch form analysis and template generation. In addition, temporomandibular joints, sinus and airway analysis are included in this comprehensive patient analysis.

43 CELLS IN DAILY ORTHODONTICS
J Maltha, Department of Orthodontics and Oral Biology, Radboud University Nijmegen Medial Centre, The Netherlands
KEYNOTE ADDRESS

Orthodontists are interfering in a complex biological system in their daily practice, and their treatment planning is to a large extent dictated by its limitations and potentialities. However, clinicians more often base their treatment planning on experience, than on biological evidence. This presentation will focus on the biological processes that enable orthodontists to move teeth through bone. The morphological and histological characteristics of the tissues involved will be briefly reviewed, but most emphasis will be put on the cells, which are the entities that have to do the work. Fibroblasts, osteoblasts, cementoblasts, and osteoclasts are the most important cells involved. Their normal physiological role will be discussed, as well as the effects of changes in mechanical conditions on their functioning.
Fibroblasts are responsible for the turnover of the periodontal ligament (PDL) and the continuity of its function. The latter, however, is not possible without an intimate collaboration with cementoblasts and osteoblasts, which are responsible for the deposition of cementum and bone, and thereby for the attachment of the PDL fibres. Osteoclasts are responsible for normal bone turnover, and they 'clear the way' for orthodontic tooth displacement. Their recruitment depends on signals from fibroblasts, and they can only perform their task after preconditioning of the bone surface by osteoblasts. This means that daily orthodontic practice is strongly dependent on the interaction between these different cell types and that clinicians should take the biological limitations of this system into account when planning treatment.

44 TISSUE REACTION TO IMMEDIATE LOADING OF TEMPORARY IMPLANTS
B Melsen, University of Aarhus, Denmark

AIM: Skeletal anchorage has become increasingly popular. The time between placement and

loading is, however, still not completely clarified. The aim of this study was to analyze the clinical and histological reaction to immediate loading of mini-implants inserted in *Macaca fascicularis* monkeys.
MATERIALS AND METHOD: A total of 32 mini-implants were inserted into eight adult monkeys, two in each side of the infrazygomatic crest (trabecular bone) and two in the mandibular symphysis (cortical bone). They were loaded immediately following insertion with a coil spring delivering a force of 50 cN perpendicular to the long axis. At the end of the observation time of 4, 8 and 12 weeks, the animals were sacrificed and the implant and surrounding bone excised and prepared for histomorphometric evaluation. The bone-to-implant contact and bone density within 1 mm of the implant were evaluated.
RESULTS: Three mini-implants were lost, all within the first weeks and all related to lack of primary stability. Histomorphometric analysis demonstrated that the bone-to-implant contact increased from 22 per cent after 4 weeks to 80 per cent at the end of the experiment. The relative bone density also increased but there was much individual variation (averaging 10 per cent after 4 weeks to 66 per cent after 12 weeks). The variation reflected the differences in the original density of bone at the insertion site. The bone adjacent to the implants showed marked remodelling throughout the observation period, reflecting the difference in stiffness of the bone and implant.
CONCLUSION: For initial stability, mini-implants can be loaded with moderate forces. Loading from applied forces, but also from function, contributed to an increase in both bone-to-implant contact and bone density.

45 POSITIONER TREAMENT: ARE PATIENTS SATISFIED?**
R-R Miethke, V Nedwed, A Kaul, Charité-University Medicine Berlin, Germany

AIM: Eighty-seven per cent of patients who attended orthodontic consultations were concerned regarding crowding of their anterior teeth but were unwilling to undergo treatment using a traditional labial or lingual appliance. They were, therefore, treated with the Invisalign system. The question to be answered in this study was: How satisfied were patients with their treatment?
MATERIALS AND METHOD: Little's Irregularity Index was used to assess the malalignment of the anterior teeth of 36 consecutive patients before and after treatment. A questionnaire with 12 questions was completed by 54 consecutive patients after a treatment period of 3 to 6 months. The questions dealt with the adaptation period, speech impairment, tongue irritation, general pain and individual satisfaction.
RESULTS: The mean initial Irregularity Index was 5.8 but at the end of treatment, this had reduced to 0.5. For 83 per cent of subjects it took only 1 week to adapt to the aligners, 98 per cent had no or only minor speech impairment, while 93 per cent felt so 'safe' that they did not avoid any speech contacts. Seventy per cent had no tongue irritations, while 24 per cent noticed minor problems. In 54 per cent of the patients the aligners caused little pain and in 11 per cent no pain at all. This lasted for approximately 2 or 3 days after insertion of a new aligner. At the time of their interview, 89 per cent were satisfied with their treatment.
CONCLUSIONS: This system is effective in correcting irregularities of anterior teeth and causes only minor impairment. Therefore, it is a valid alternative especially for aesthetically demanding individuals who cannot be treated with traditional labial or lingual appliances. Overall, Invisalign is a satisfactory treatment modality for patients.

46 DISTRACTION OSTEOGENESIS: CLINICAL EVIDENCE FROM SYSTEMATIC RESEARCH
M Mommaerts, GH St Jan Bruges and GH St Elisabeth Herental, Belgium
KEYNOTE ADDRESS

Narrow apical bases may lead to anterior crowding. Unlike sagittal and vertical skeletal

discrepancies, transverse hypoplasia without a buccal crossbite is not routinely corrected by surgery, being more frequently compensated for by dental extractions. When premolars are sacrificed and the intercanine distance is orthodontically increased, dental crowding is known to relapse unless permanent retention is provided. The advent of distraction osteogenesis in the cranio-maxillo-facial region has introduced the possibility of expanding the jaw bases and thereby the intercanine width without moving the canines out of their bony envelope. Thus orthodontic relapse, but not tertiary crowding, will theoretically be reduced.
Transpalatal and transmandibular distraction require bone-borne distractors and a surgical protocol. New techniques such as these necessitate validation before their routine application can be recommended. Prospective studies were set up to search for evidence and to modify the hardware or the procedure when deemed necessary. For transpalatal distraction, the fourth generation of distractor coped with earlier problems that were encountered. The approach for maxillary corticotomies changed from an open oral vestibular to an endoscopically assisted transnasal corticomy. Unilateral distraction and the use of a distractor without corticotomies have been studied in children. In transmandibular osteodistraction, changes in condylar position, periodontal status and surgical disruption of the supporting structures and dental components have been studied in animal experiments and under clinical conditions. Post-retention stability of the expansion has also been analysed. Two osteotomy designs have resulted and refinements in hardware and surgical technique have considerably improved patient tolerance. Bimaxillary transverse osteodistraction has therefore become a reliable instrument in our current armamentarium, providing a consistent treatment outcome.

47 VISUALISING THREE-DIMENSIONAL FACIAL CHANGES FOLLOWING ORTHOGNATHIC SURGERY

D O Morris[1], L Miller[2], E Berry[2], [1]Seacroft Hospital and [2]Medical Physics Unit, Leeds, England

AIM: To determine the performance of four different methods of visualisation in communicating surgical changes to observers.
MATERIALS AND METHOD: A single-centre longitudinal cohort study based in an academic hospital department was undertaken. Three groups were studied: 16 female mandibular advancement patients (group A), 13 male bimaxillary Skeletal III patients (group B) and a control group of 12 non-growing adults (group C). Pre- and post-operative facial laser scans were registered and superimposed. Differences between the scans were analysed using four colour visualisation methods: normals, radial, closest point and correspondences with sensitivity to movement. A group of 10 observers were asked to determine the surgical procedure (if any) undergone by each subject. Sensitivity and specificity values were calculated and intra-observer agreement assessed by Cohen's kappa.
RESULTS: There was a strong degree of subjectivity involved in the interpretation of the colour visualisations. Although highly specific (range 81-100 per cent), the highest sensitivity was 60 per cent. The more complex facial movements in the group B subjects were not well represented by any of the methods used. Intra-observer repeatability was good (kappa = 0.61).
CONCLUSIONS: No single visualisation method performed best for all the procedures. Each method allowed correct identification of different proportions of the subject groups. Further investigations into the registration process are planned.

48 TREATMENT OUTCOME AFTER TWO-STAGE PALATAL CLOSURE IN UNILATERAL CLEFT LIP AND PALATE SUBJECTS

P M Nollet, C Katsaros, A M Kuijpers-Jagtman, Radboud University Nijmegen Medical Centre, The Netherlands

AIM: There is still no generally accepted treatment protocol in unilateral cleft lip and palate

(UCLP) patients. In particular, the timing of palatal closure remains controversial. The aim of this study was to evaluate a group of UCLP patients treated according to two-stage palatal closure (Nijmegen) and to compare it with the six Eurocleft centres.
SUBJECTS AND METHOD: The dental arch relationship was evaluated with the Goslon Yardstick. All Nijmegen patients (n = 43) were treated with a two-stage palatal closure: soft palate closure at 11-13 months of age and hard palate closure at 4-11 years of age. The Nijmegen Goslon scores were compared with the Goslon outcomes of the six Eurocleft centres and possible relationships between treatment protocols and Goslon outcomes were evaluated.
RESULTS: For the Nijmegen UCLP group, 9 per cent of the patients had a Goslon score of 1 (favourable antero-posterior relationship), 52 per cent a score of 2, 30 per cent scored 3 and 9 per cent scored 4. No patient had a score of 5 (meaning orthognathic surgery was required). The mean Nijmegen Goslon score (2.36, SD 0.74) showed no significant differences when compared with Eurocleft centres A, B and E, which achieved the best treatment results. However, they differed significantly from Goslon outcomes of Eurocleft centres D ($P < 0.001$), C and F ($P < 0.01$), which had relatively poor treatment outcomes. Nijmegen and Eurocleft centres A, B and E had high volume operators but the treatment protocols were not the same. The protocols of Nijmegen and centre A with delayed palatal closure differed substantially from the protocols of Eurocleft centres B and E where the anterior hard palate was closed at 2-3 months of age.
CONCLUSIONS: Treatment protocol does not have a major influence on the dental arch relationship. The caseload or skill of the surgeon might be more important factors for the quality of the results.

49 A SCANNING ELECTRON MICROSCOPIC EXAMINATION OF ENAMEL EXPOSED TO THREE DIFFERENT ORTHODONTIC BONDING SYSTEMS

B Øgaard[1], M Fjeld[2], [1]Institute of Clinical Dentistry and [2]Department of Orthodontics, Oslo, Norway

AIM: To investigate the effect of (i) conventional etching with a 35 per cent phosphoric etching solution and priming/bonding with Transbond XT primer/adhesive, (ii) conditioning with 10 per cent polyacrylic acid and bonding with a resin-modified glass-ionomer cement (RMGIC; Fuji Ortho LC) or a self-etching bonding system (Transbond Plus), and (iii) bonding with Transbond XT adhesive on the surface morphology of the enamel. Satisfactory bond strengths have been obtained with these systems in a previous study (Movaheed *et al*., 2005).
MATERIALS AND METHOD: The buccal enamel surface of extracted premolars (5 in each group) were conditioned with one of the three systems and evaluated by environmental scanning electron microscopy. Brackets were subsequently bonded with one of the bonding agents, the teeth cut along their long axis through the bracket and the cut surface examined by conventional scanning electron microscopy.
RESULTS: The three bonding systems induced different effects on the enamel structure. Phosphoric acid etching produced a rough, etched surface with a typical 'honeycomb' pattern. Bonding brackets to such a surface resulted in thick, relatively deep, resin tags (50 μ) into the enamel. Less pronounced etching of surface enamel was obtained by the self-etching primer system and bonding resulted in smaller and fewer resin tags. The RMGIC bonded after conditioning the enamel with polyacrylic acid showed no resin tags.
CONCLUSIONS: Bonding systems using self-etching primers or conditioners with polyacrylic acid may offer potential benefits compared with conventional acid etching and priming due to fewer irreversible changes of the enamel morphology.

50 CEPHALOMETRIC ALTERNATIVES

M Palmer, Private Practice, Berlin, Germany
KEYNOTE ADDRESS

This presentation will attempt to define why alternatives are required to conventional cephalometric analysis. Some basic assumptions will be challenged and the clinical problems associated with using conventional cephalometrics for individual orthodontic diagnosis and treatment planning will be highlighted.
The main part of the presentation will concentrate on orthodontic diagnosis and treatment planning based on individual aesthetics rather than mathematical parameters. The concept of an individual aesthetic face and the factors that contribute to and are essential for a positive dentofacial aesthetic image will be presented.

51 LONG-TERM SUCCESS OF AUTOTRANSPLANTED MAXILLARY CANINES: A RETROSPECTIVE INVESTIGATION

S A Patel, M Bains, D Bister, Queen Mary's Hospital & GKT Hospital, London, England

AIM: Impacted maxillary canines affect approximately 2 per cent of the population. Orthodontic alignment is the gold standard, but in up to 19 per cent of patients unwanted side-effects have been observed including: ankylosis, long treatment time, loss of vitality, discolouration, loss of periodontal support with unsightly gingival margins, and significant post-orthodontic movement. Occasionally the canine presents in a position, which makes alignment unfeasible, or orthodontic treatment is refused. In such patients alternatives such as autotransplantation may be desirable. The aim of this study was to assess, clinically and radiographically, the long-term outcome of autotransplanted canines.
SUBJECTS AND METHOD: One hundred and ninety one patients who had undergone autotransplantation were contacted by mail and asked to attend a review clinic. Investigations included clinical examination (colour, mobility, gingival margin, probing depth, percussion) and comparison with the tooth on the contralateral side. Radiographic examination included periapical films and, when indicated, dental pantomograms. The films were screened for previous root canal treatment, loss of periodontal support, outline of the periodontal ligament, and internal/external root resorption.
RESULTS: Fifty-two patients replied (27 per cent response rate) and, of those, 45 were included in this study. Eighty-one per cent of transplanted teeth were still *in situ* over a 25.8 year time period. A total of 58 transplanted teeth were included, with the average age at transplantation being 22.4 years.
CONCLUSIONS: Autotransplantation of impacted maxillary canines can be successful in the long term and may be indicated in selected circumstances. However, individual success is unpredictable and patients must be informed of the failure potential before undergoing such procedure.

52 EFFECT OF ACTIVATOR TREATMENT IN GROWING PATIENTS AFTER UNILATERAL VERTICAL RAMUS LENGTHENING

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AIM: In subjects with mandibular asymmetry caused by growth failure after condylar injury, early vertical diststraction osteogenesis (DO) of the ramus can be an option to correct the skeletal asymmetry and bring the mandibular occlusal plane to a horizontal level. In theory, the upper occlusal plane should then be levelled by 'catch-up' vertical growth of the upper dentoalveolar area on the affected side. The aim of this study was to demonstrate longitudinally the post-distraction changes during a following course of activator treatment.
SUBJECTS AND METHOD: Fifteen patients (eight females and seven males) with a similar asymmetry caused by a short ramus. The asymmetry was caused by juvenile arthritis in seven subjects, trauma in four, hemifacial microsomia (type I) in two, early arthrosis in one and

temporomandibular joint infection in one. The mean age was 12.6 years (SD 1.85) at the time of DO. Fixed appliances, together with a supporting splint, were used during the 3 weeks of active DO followed by a healing period of 8 weeks. Immediately after the active period, the supporting splint was adjusted in the region of the first molar on the affected side in order to allow passive eruption. Four weeks after removal of the DO appliance, the orthodontic appliance was removed and an activator allowing for eruption of the upper posterior teeth on the affected side was inserted. Lateral and frontal head films were taken before, after, and 6 months after removal of the DO appliance.
RESULTS: Analysis of the cephalograms showed uprighting and forward movement of the mandible. There was significant vertical development of the maxilla following activator treatment, with subsequent levelling of the oblique upper occlusal plane.
CONCLUSION: Activator therapy combined with DO constitutes a useful treatment procedure in treating asymmetries.

53 MUTATION SCREENING OF THE IRF6 GENE IN SWEDISH FAMILIES WITH NON-SYNDROMIC CLEFT LIP AND PALATE

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AIM: Non-syndromic cleft lip and palate (NSCLP) is a failure of the nasal processes and/or palatal shelves to fuse during weeks 4-12 *in utero*. The aetiology of CLP is complex but with a clear genetic component. The interferon regulatory factor 6 (IRF6) gene, from chromosome 1q32.2 has been implicated as the gene defect in Van der Woude syndrome. The aim of this investigation was to screen the IRF6 gene for mutations in Swedish NSCLP families.
SUBJECTS AND METHOD: Blood samples were collected from children born with CLP/CP in the Stockholm area and from other family members. A total of 17 families containing at least two affected individuals each were recruited. One affected and one healthy subject per family were screened for mutation analyses. Genomic DNA was extracted using a non-enzymatic method. DNA fragments, including exons 1-9 of the IRF6 gene, were PCR amplified and direct sequenced from both sides of each exon using Dye-terminator chemistry. Sequencing products were electrophoresed and analysed on a MegaBACE instrument. Sequences were aligned and inspected visually to detect any polymorphisms, using the Gap 4-program (Staden).
RESULTS: Analysing the IRF6 gene, seven polymorphisms were observed in the gene promotor and intronic regions, as well as a silent polymorphism in exon 5. However no coding mutations were detected in the IRF6 gene in these NSCLP families.
CONCLUSION: When screening the IRF6 gene for mutation in Swedish NSCLP families, polymorphisms were found but no coding mutations. Further tests should be performed in order to see if any of these polymorphisms are associated with an increased risk of NSCLP.

54 FACTORS INFLUENCING LONG-TERM MANDIBULAR INCISOR ALIGNMENT AFTER EXTRACTION TREATMENT

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AIM: To retrospectively study the influence of independent dental and skeletal variables on post-retention incisor irregularity.
SUBJECTS AND METHOD: Fifty-seven adolescent patients (24 males and 33 females) with a Class II division 1 malocclusion who were treated with premolar (n = 44) or molar (n = 13) extractions and fixed appliance therapy. Data was obtained from dental study casts and lateral cephalograms at pre-treatment (T1), post-treatment (T2), and at least 3 years post-retention (T3). This data described pre-treatment characteristics, changes during treatment, status at the end of

treatment and post-treatment changes. Two subgroups were defined at T3 based on mandibular incisor alignment scores (Little's Irregularity Index): an 'acceptable' subgroup (< 3.5 mm) and an 'unacceptable' subgroup (≥ 3.5 mm). Logistic regression analysis was then used to test whether a relationship existed between these two subgroups and the independent variables.
RESULTS: The mean Irregularity Index scores at T1, T2 and T3 were 3.7 ± 2.5 mm, 1 ± 1.1 mm and 2.9 ± 1.9 mm, respectively. The mean scores at T3 for the acceptable (n = 36) and unacceptable (n = 21) subgroups were 1.7 ± 1.1 mm and 4.9 ± 1.3 mm, respectively. Initial bivariate analysis found that nine variables were significantly related to acceptable/unacceptable mandibular incisor alignment at T3. However, following multiple logistic regression, only intercanine width (T3-T2) remained significant (P = 0.0042). Patients with a decrease in intercanine width greater than 1.5 mm were six times more likely to exhibit increased incisor irregularity at T3 than those with a decrease of less than 1.5 mm.
CONCLUSION: Overall, relapse was unpredictable as no single factor, except change in intercanine width (T3-T2), was found to have a significant influence on mandibular incisor alignment post-retention (T3). The results indicate that control of intercanine width post-treatment is important to ensure incisor alignment.

55 OBSTRUCTIVE SLEEP APNOEA SYNDROME IN CHILDREN: THERAPEUTIC EFFECTS OF RAPID MAXILLARY EXPANSION

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AIM: To evaluate whether rapid maxillary expansion (RME) therapy could improve both the patency of the nasal airways and obstructive sleep apnoea (OSA).
SUBJECTS AND METHOD: Forty-two children with a history of oral breathing, snoring and nighttime apnoeas were studied. Selection criteria were: no adenotonsillar hypertrophy, a Body Mass Index below 24 and a malocclusion characterised by a narrow upper jaw, as determined by postero-anterior (PA) cephalometric evaluation. The patients underwent an ear, nose and throat examination, with auditory and respiratory tests, including a daytime sleepiness questionnaire, 19-channel polysomnography, and a dental and radiographic investigation. All the investigations were carried out before orthodontic therapy (T0), after one month (T1) with the device *in situ*, and 4 months after the end of the orthodontic treatment (T2). All the upper jaw and nasal septum changes induced by RME were analysed by PA cephalometric evaluation at T0, T1 and T2.
RESULTS: In all treated subjects, an opening of the midpalatal suture was obtained which was confirmed both by intraoral occlusal radiographs and PA cephalograms. The results showed that RME therapy widened the nasal fossa and released the septum thus restoring normal nasal airflow with disappearance of obstructive sleep disordered breathing.
CONCLUSIONS: Changing the anatomic structure by RME resulted in significant functional improvement. Therefore the orthodontist can play an important role in the interdisciplinary treatment of OSA patients.

56 MAGNETIC RESONANCE IMAGING OF TEMPOROMANDIBULAR JOINT DYSFUNCTION

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AIM: To prospectively evaluate the relationships between signs and symptoms of temporomandibular dysfunction (TMD) and the radiological changes in the temporomandibular joint (TMJ) in orthodontic/orthognathic treatments.
SUBJECTS AND METHOD: Twenty-one adults (18 females, 3 males, mean age 34.1 years, range 21 to 57 years) with severe TMD who underwent orthodontic/orthognathic treatment. All patients were examined according to Helkimo's Dysfunction Index and, additionally, a magnetic resonance

image (MRI) examination of the TMJs and a conventional radiological examination were performed before and one year after active treatment.
RESULTS: Helkimo's Dysfunction Index showed a significant improvement in TMD, with a mean score of 11.1 (SD 4.58) before treatment and 4.5 (SD 3.68) after treatment. The MRI findings showed a marked decrease in the number of patients with joint effusion. There were small changes in the number of diagnosed disc dislocations. In 71 per cent of the patients there was a unilateral or bilateral anterior disc displacement before treatment and in 67 per cent after treatment. In 47 per cent of the patients the condylar shape was normal bilaterally on MRI before treatment and in 29 per cent after treatment. There was no correlation between condylar changes and changes in TMD.
CONCLUSIONS: The significant decrease in TMD after orthodontic/orthognathic treatment is likely to be a consequence of improved occlusal function, which, in turn, is related to favourable changes in muscular balance. The frequent resorptive changes in condylar form may reflect remodelling and adaptation after intensive treatment.

57 LONG-TERM RESULTS OF MULTIDISCIPLINARY TREATMENT OF AGENESIS

C E Poggio, M Salvato, A Salvato, Milan University, Italy

AIM: To investigate the long-term clinical outcome of multidisciplinary treatment with implants in subjects with agenesis.
SUBJECTS AND METHOD: Forty-six implants were placed in 24 consecutively treated patients (mean age 22.5 years). All had been previously treated orthodontically either several years before, or immediately before surgery. All implants were restored with metal-ceramic crowns on customized screw retained abutments. The observation period ranged from 32 to 141 months (mean 60.3 months).
RESULTS: No implant failures were registered. Of the restorations, 17.5 per cent had prosthetic complications (screw loosening) but none of them required a new crown. Screw loosening resulted in peri-implant tissue inflammation, which resolved after screw tightening. Soft tissue conditions around the restorations were comparable with the patient's natural teeth. In the anterior region, an acceptable and stable aesthetic appearance was found in most subjects, although in four patients a change in the relative position of the implant-supported crown to adjacent teeth was clinically evident leading to infraocclusion. No infraocclusion was evident in the posterior area.
CONCLUSIONS: Overall, dental implants are a good treatment option for replacing developmentally missing teeth. However the effects of post-adolescence craniofacial changes are still largely unknown, as well as the response of an implant-supported crown to complex long-term occlusal changes. The choice between orthodontics alone or multidisciplinary treatment should always be carefully considered at the time of diagnosis and treatment planning.

58 PLACEMENT OF ORTHODONTIC MICRO-IMPLANTS USING AN IMAGE-GUIDED NAVIGATION SYSTEM

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AIM: Computer-assisted surgery has improved the reliability of implant placement, but has not previously been adopted for orthodontic indications. The aim of this study was to investigate the suitability of the computer-assisted implant planning and surgery system, Robodent™, for orthodontic micro-implants serving as anchorage devices in the maxillary retromolar region.
MATERIALS AND METHOD: Twelve formalin fixed upper jaws with nearly complete dentitions were used. Spiral computed tomographs of all jaws were performed. Planning data were transferred to the navigational system as Dicom data sets, allowing pre-operative determination of the implant position with the aid of the three-dimensional planning tool, which is part of the Robodent™ system. The implants were placed in the retromolar region of the maxilla under direct

control of the navigation system that guided the drilling of the implant socket according to the axes and lengths of the implants previously planned. Post-operative computed tomographs were taken to compare the planned with the finally achieved implant position. Variations between planned and achieved position were measured at the tip and the neck of the implants comparing pre- and post-operative tomographs.
RESULTS: A total of 24 screw implants (diameter 1.5 mm, length 13.0 mm) were inserted; all implants showed adequate primary stability. Differences between pre-operatively planned and achieved implant position showed an average difference of 0.8 ± 0.3 mm.
CONCLUSION: Use of the Robodent™ image-guided navigation system may provide a valuable tool for implant placement in orthodontics. Further studies are necessary to determine if this tool improves the reliability of implant-based anchorage and if high costs and sophisticated planning can be justified by improved clinical results.

59 THE GENETIC FUNCTIONAL MATRIX THEORY

A B M Rabie, University of Hong Kong, SAR China

AIM: Based on an extensive literature review, the functional matrix hypothesis was revisited in the nineties by Moss. In his series of publications, interactions between epigenetic processes and cells and their products leading to morphogenesis were considered to be responsible for 'all cranial development'. Completion of 'the genome project' provided an opportunity to examine the validity of the 'functional matrix theory' through the use of microarray technology, real time RT-PCR and knock out gene technology. Due to the enormity of the task at hand, it was decided to begin by examining 'condylar growth'. Bone fracture healing is a common experimental model to study natural bone growth. Similarly, it was demonstrated that condylar growth induced by mandibular advancement mirrored natural growth. Thus mandibular advancement offers a good model to study condylar growth. It was, therefore, decided to carry out micro-array analysis of thousands of genes expressed during condylar natural growth, and during growth induced by mandibular advancement. In this way, interactions between epigenetic and genetic factors could be studied.
MATERIALS AND METHOD: Two hundred and eighty rats were divided into seven experimental (advancement) and seven control groups. The rats were sacrificed at different time points and total RNA was extracted for microarray and RT-PCR. The analysis was limited to genes that showed a 2 or more fold change using 'gene spring' software.
RESULTS: Six hundred and twenty four genes showed a significant change between groups. Knock out genes of five different identified genes demonstrated either absence or major impairment of skeletal tissues, while normal growth of soft tissues was evident.
CONCLUSION: Genes play a fundamental role in modulating condylar growth. Levels of expression of these genes are influenced by the surrounding functional matrix**.** Evidence is therefore provided to warrant a renaming to 'The genetic functional matrix theory'.

60 PERIODONTAL VASCULATURE PROFILES DURING STANDARDIZED ORTHODONTIC TOOTH MOVEMENT IN YOUNG AND ADULT RATS

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AIM: To undertake morphometric analysis of changes in periodontal surface area and vasculature in young and adult rats during standardized orthodontic tooth movement.
MATERIALS AND METHOD: Two groups of 30 rats, aged 6 weeks and 9-12 months, were used. Standardized orthodontic appliances were placed on the experimental sides to move the three maxillary molars mesially with a force of 10 cN. The contralateral sides served as controls. At 1, 2, 4, 8, and 12 weeks groups of animals were sacrificed. Sections were stained for alpha-smooth muscle actin as a marker for blood vessels. The surface area of the periodontal ligament (PDL), the

relative surface area of the periodontal blood vessels, the mean blood vessel number and diameter were determined.
RESULTS: In control groups, the surface area of the PDL remained stable over time, but it was smaller in the adult animals ($P < 0.01$). On the experimental compression sides, a significant ($P < 0.05$) but transient decrease of the surface area was found in the young rats after 1 week, and in the adults after 2 and 8 weeks. The relative blood vessel surface area increased significantly over time in the young rats ($P < 0.01$), but remained stable in the adults. The number of blood vessels was significantly higher on the experimental sides than in the controls ($P < 0.01$). The mean diameter of the blood vessels was larger in the adult animals ($P < 0.05$), and did not change during the experimental period.
CONCLUSIONS: An orthodontic force induces a transient decrease in the periodontal surface area and an increase in the relative blood vessel surface area, which is more pronounced in young animals. Overall the periodontium and its vasculature recover faster in young rats. Once tooth movement has reached its linear stage, the vascular profile remains relatively stable, indicating a new metabolic balance in the periodontium.

61 CLEFT PALATE: SIGNALS AND TISSUE INTERACTIONS DURING EARLY DEVELOPMENT

D P C Rice, King's College London, England

AIM: The palatal shelves develop bilaterally as buds from the maxillary processes lengthen prior to their fusion in the midline. Classical experiments have suggested that this early development is regulated by epithelial-mesenchymal tissue interactions. The aim of this study was to discover which molecular signals control early palate morphogenesis through epithelial-mesenchymal interactions.
MATERIALS AND METHOD: Both wild type and transgenic mouse tissue were used, and by *in situ* hybridization the genes which are active during early palatogenesis were analyzed. Cell turnover assays were performed using BrdU and TUNEL protocols. An organ culture system was used to assess the nature of tissue-tissue interactions and the effect of exogenous growth factors.
RESULTS: Using fibroblast growth factor 10-/- (Fgf10-/-) Fgfr2b-/- and Sonic hedgehog (Shh) mutant mice, which all exhibit cleft palate, it was shown that Shh is a downstream target of Fgf10/Fgfr2b signalling. This was verified by demonstrating that recombinant FGF10 induces Shh in palatal organ culture. These results show that mesenchymal Fgf10 regulates the epithelial expression of Shh, which in turn signals back to the mesenchyme. This was confirmed by demonstrating that cell proliferation is decreased, not only in the palatal epithelium, but also in the mesenchyme of Fgfr2b-/- mice.
CONCLUSION: These results reveal a new role for FGF signalling in mammalian palate development. Co-ordinated epithelial-mesenchymal interactions are essential during the initial stages of palate development and are under the control of an FGF-Shh signalling network.

62 TREATMENT OF OBSTRUCTIVE SLEEP DISORDERED BREATHING WITH A MANDIBULAR PROTRUSIVE APPLIANCE – A CASE CONTROL STUDY

E C Rose, S Sorichter, I E Jonas, University of Freiburg, Germany

AIM: Mandibular protrusive appliances have long been used to treat obstructive sleep apnoea/hypopnoea (OSAH). In this study the efficacy of a two-splint appliance on nocturnal breathing disorders, sleep profile, and daytime sleepiness were evaluated according to a specially-designed treatment procedure.
SUBJECTS AND METHOD: Forty-two consecutive OSAH patients, who had been fitted with a mandibular protrusive appliance according to a preset treatment regimen, were included in a follow-up analysis. The diagnosis and the degree of severity of OSHA were determined by

polysomnography in the sleep laboratory. The treatment regimen, established with the sleep laboratory physician, included the diagnostic procedure in the sleep laboratory, a dental examination to establish individual requirements, the fabrication of the appliance to be used, and titration of the required mandibular protrusion. Following wear of the appliance for 24.5 ± 7.8 days, 34 patients underwent repeat overnight polysomnography.
RESULTS: The mean apnoea/hypopnoea index (AHI) decreased significantly from 19.6 ± 12.8 to 3.3 ± 7.8 events per hour; the apnoea index also improved significantly, as did minimal oxygen saturation and the desaturation index. A therapeutically required AHI of below 5 events per hour was achieved in 88.2 per cent of the patients. Changes in sleep profile did not reach statistical significance; however, the arousal index ($P < 0.02$) and the subjectively assessed daytime sleepiness ($P < 0.02$) decreased significantly.
CONCLUSION: A significant improvement in the respiratory situation of the vast majority of OSAH patients was noted, particularly in their AHI.

63 BIOLOGICAL TECHNOLOGY IN YOUR CLINIC

J Sandy, Division of Child Dental Health, University of Bristol Dental School, England
KEYNOTE ADDRESS

Orthodontists are extremely good at translating technological advances into daily clinical practice, be it in a bracket system or advances in material science that influences their choice of wires. What they are less good at is understanding what influence this has on biology. There are also advances in biomedical sciences that could translate into an improved understanding of patient care and treatment methods.
The aim of this presentation will be to update the biological advances relevant to clinical orthodontic practice. Three main areas will be covered. The first relates to the current understanding of bone remodelling and some of the molecular signals that are responsible for control of bone cells. The second area is how gene manipulation has improved our understanding of bone and craniofacial development, and the third domain deals with how molecular technologies could eventually improve clinical practice.

64 CONTEMPORARY ORTHODONTICS AND THE PROGRESSION TO SOFT TISSUE BASED DIAGNOSIS AND TREATMENT PLANNING

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KEYNOTE ADDRESS

In the era of the new ‘soft tissue paradigm’, contemporary orthodontic treatment planning is making a logical transition from emphasis on hard tissue to hard and soft tissue interactions. Diagnosis and treatment planning has relied on static records such as the cephalogram, models, and photographs. In contemporary planning, dynamics such as smile design and incorporation of the concepts of facial maturation and ageing are important features of the new approach. Records and evaluation now include more dynamic entities such as biometric tools for direct clinical evaluation and digital video technology. How do we assess a smile on a lateral cephalogram?
A systematic evaluation and classification of the smile has been developed for smile quantification in all three physical dimensions, with a logical transfer to the fourth dimension – time. Drawing on lessons from aesthetic dentistry, how orthodontic aesthetics can be greatly improved with cosmetic tooth contouring as well as the exciting incorporation of new technology to further refine and enhance clinical cases.

65 SKELETAL ANCHORAGE SYSTEM: BEYOND THE LIMITS OF TRADITIONAL ORTHODONTICS

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Japan
KEYNOTE ADDRESS

The skeletal anchorage system (SAS) consists of titanium orthodontic anchor plates that are temporarily implanted in the zygomatic buttress and/or the mandibular body with monocortical titanium screws. Since the anchor plates function as absolute orthodontic anchorages, it has become possible to move the molars three-dimensionally with the application of SAS. Consequently, SAS has enabled us to dramatically camouflage various types of skeletal malocclusions beyond the limits of traditional orthodontics. In addition, this innovative non-compliance technique rarely requires extraction of the premolars.

66 PRESENTATION AND VALIDATION OF THREE-DIMENSIONAL HARD AND SOFT TISSUE CEPHALOMETRIC ANALYSIS

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AIM: To present and validate a new three-dimensional (3D) hard and soft tissue cephalometric analysis.
MATERIALS AND METHOD: Computed tomographic data (DICOM 3.0 files) of 20 subjects with normal skeletal relationships were used. To investigate accuracy and reliability of 3D cephalometry (Maxilim™, version 1.3.0) a total of 36 angular, 78 linear measurements and 164 (54 horizontal, 54 vertical and 54 transverse) orthogonal measurements were performed on each patient twice by two investigators.
RESULTS: Intra-observer measurement error was less then 0.85 degrees for angular measurements and less than 0.78, 0.88, 0.76 and 0.84 mm for linear, horizontal, vertical and transverse orthogonal measurements, respectively. The inter-observer measurement error was less than 1.03 degrees for angular measurements and less than 0.84, 0.78, 0.86 and 1.26 mm for linear, horizontal, vertical and transverse orthogonal measurements, respectively. Squared correlation coefficients showed a high intra- and inter-observer reliability.
CONCLUSIONS: The presented 3D cephalometric hard and soft tissue analysis was found to be highly accurate and reliable. 3D cephalometry presents a useful objective tool for virtual evaluation of craniofacial morphology and planning of combined orthodontic-surgical procedures.

67 ICEPH – AN AUTOMATIC RECOGNITION OF THE HUMAN FACE

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KEYNOTE ADDRESS

Mathematical formulation of the decision-making process in orthodontic diagnosis and treatment planning is indispensable in achieving evidence-based practice. This presentation will introduce an intelligent system that facilitates automatic recognition of the human face on cephalograms and standard photographs. The system is based on complex image recognition modelling techniques and provides a robust performance at high speed.

68 TNF-ALPHA INDUCED APOPTOSIS OF OSTEOCYTES IS INHIBITED BY MECHANICAL LOADING

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AIM: It is generally accepted that osteocytes are mechanosensitive bone cells, and mechanical regulation of osteocyte (OCY) death, i.e. apoptosis, is supposed to play a key role in this remodelling event. TNF-alpha is a pro-inflammatory catabolic cytokine with apoptotic potency,

and elevated levels are found in the gingival sulcus during orthodontic tooth movement. In this study, the aim was to investigate if mechanical loading could affect TNF-alpha induced osteocyte apoptosis.
MATERIALS AND METHOD: OCY, osteoblasts (OB), and periosteal fibroblasts (PF) were isolated from foetal chicken calvaria via enzymatic digestion. Separation of periosteum from the calvaria was undertaken to obtain PF. Mab 7.3, an antibody specific for OCY, was used to separate OCY from OB by immunomagnetic separation. Apoptosis was induced by 10 ng/ml TNF-alpha for 16 hours. Subsequently, the cells were treated for 1 hour with a pulsating fluid flow shear stress (PFF, 0.70 ± 0.30 Pa, 5 Hz) or were kept under static conditions. After a 24-hour post-incubation period without loading, apoptosis was assessed as caspase 3/7 activity using the Caspase-Glo 3/7 assay. The values were corrected for the amount of DNA.
RESULTS: Treatment with 10 ng/ml TNF-alpha increased the caspase 3/7 activity of both OCY and OB by ×2.2 compared with untreated cultures. TNF-alpha did not affect caspase 3/7 activity of PF. Treatment with PFF reduced the TNF-alpha induced caspase 3/7 activity in OCY compared with static cultures by 32 per cent (n = 5). No effect of flow was seen in cultures of OB (n = 3) or PF (n = 4).
CONCLUSION: Mechanical loading by PFF inhibits TNF-alpha induced apoptosis of OCY. Apoptosis of OB and PF, however, could not be inhibited by PFF. Therefore, these data suggest a regulatory role for osteocyte apoptosis after application of an orthodontic load.

69 NITRIC OXIDE SYNTHASE ACTIVITY AND MATURATION OF GROWTH PLATE CHONDROCYTES

C Teixeira, New York University College of Dentistry, USA

AIM: Recent research has shown that growth plate chondrocytes generate nitric oxide (NO) to levels similar to those reported for osteoarthritic chondrocytes. In addition, inhibition of NO synthase (NOS) activity or deletion of endothelial NOS, results in skeletal defects and growth retardation. Surprisingly, little is known on the role of NO in growth plate physiology. The aim of this investigation was to determine the role of NOS in growth plate chondrocyte maturation.
MATERIALS AND METHOD: Immunohistochemistry analysis was performed in the chicken epiphysis using antibodies against the three NOS isoforms, and nytrosylated products. *In vitro* studies were conducted using sternal chondrocytes, treated with retinoic acid (RA) to induce maturation. NO levels were measured by chemiluminescence, and NOS protein levels determined by Western blot analysis. Alkaline phosphatase enzymatic activity was measured spectrophometrically. To study regulation of type X collagen by NO, chondrocytes were co-transfected with a type X collagen promoter-luciferase construct, and endothelial NOS.
RESULTS: The three NOS isoforms were present in chick growth plates. The highest levels were found in hypertrophic chondrocytes, and nitrosocysteine and nitrotyrosine accumulated in the hypertrophic and calcified regions. Cultured chondrocytes treated with RA showed increased NOS isoforms protein levels. Chemiluminescence measurements indicated that chondrocytes release NO when treated with this retinoid. It was then determined if and how NO regulates two important markers of chondrocyte hypertrophy: type X collagen expression and alkaline phosphatase activity. An increase in both markers in the presence of an exogenous or endogenous source of NO was found. Induction of both type X collagen expression and alkaline phosphatase activity were blocked by inhibitors of the cGMP pathway.
CONCLUSION: These findings lend strong support to the hypothesis that NO is required for induction of the chondrocyte mature phenotype through activation of the cGMP pathway.

70 DEVELOPMENTAL BIOLOGY AND THE DEVELOPMENT OF ORTHODONTICS

I Thesleff, Developmental Biology Programme, University of Helsinki, Finland
KEYNOTE ADDRESS

Developmental biology is among the most rapidly progressing fields in biomedical and biological sciences. We have started to understand, at the level of cells, molecules and genes, how different tissues and organs, for example bones and teeth are formed. The single most important mechanism that regulates advancing development is the communication between cells. It is fascinating that the nature of the language that cells use for intercellular communication has been unravelled and that this language has been conserved throughout evolution. It consists of specific signal molecules that the cells produce and send to nearby cells providing instructions for the complex architectures of tissues and organs. The same signals also regulate the differentiation of stem cells into specialized cells such as osteoblasts, odontoblasts and ameloblasts. The signal molecules are nowadays available as proteins that can be used to induce development. For example, bone regeneration can be stimulated. It is also possible to generate transgenic mice in which signalling is activated or inhibited in specific tissues. In this way, it is possible to affect the number and shape of teeth as well as the amount of bone formation. Mutations in the signalling genes cause congenital defects including hypodontia, cleidocranial dysplasia and craniosynostosis. Mouse models offer the possibility to study the pathogenesis and to design novel treatments for these syndromes as well as for other craniofacial defects. There is hope that the advancements in developmental biology research may some day lead to novel possibilities for the orthodontist to influence the growth and development of bones and teeth.

71 DEVELOPMENT OF THE DENTITION IN VIRTUAL REALITY: AN EDUCATIONAL TOOL

F P G M van der Linden, Radboud University Nijmegen Medical Centre, The Netherlands

AIM: New technology provides the capability to display, in virtual reality, information acquired through traditional methods of study and to visualize the development of the dentition in three dimensions.
MATERIALS AND METHODS: Several previous studies provided the basis for this presentation. Analysis of nearly 100 human skulls, ranging from the pre-natal to the adult stages, and of their dentitions allowed observation of what takes place beyond our normal field of vision or even by radiographic or imaging techniques. Data collected in three large mixed-longitudinal growth studies provided numerical information. Photographs taken at short time intervals, as often as daily, during the transition of the incisors, were also available. Finally, the long-term clinical records of more than 2500 patients, followed for a minimum of 10 years out of retention, supplied information about changes that take place during adolescence.
RESULTS: It is possible to show the development of the dentition from formation of a tooth bud through to complete development of the dentition. The role of the soft tissues and the occlusion in this development are also apparent.

72 APICAL ROOT RESORPTION OF UPPER INCISORS CAUSED BY TORQUE USING THE TIP-EDGE APPLIANCE

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AIM: To determine whether root resorption occurs using the Tip-Edge appliance and whether the amount of root resorption is more pronounced during the 'torquing stage'.
MATERIALS AND METHOD: Three peri-apical radiographs were taken of 22 lateral incisors and 21 central incisors at the beginning of treatment, at the start of the final torquing stage, and at the end of treatment. The radiographs were developed, digitized and magnified (×3). The edge of the bracket, the cemento-enamel junction and the root apices were registered to define the crown and root length. For all teeth, a root resorption ratio (RRR) was calculated. A ratio of 1 indicated no root resorption.

RESULTS: For the central incisors, the RRR during the first phase of treatment was 0.96 (SD = 0.08), which was statistically significant. During the torquing phase no statistically significant amount of root resorption was found (RRR = 0.97 SD = 0.08). The mean RRR during the whole treatment was 0.92 (SD = 0.06), which was statistically significant. For the lateral incisors, the RRR during the first phase was 0.93 (SD = 0.06) and during the torquing phase 0.92 (SD = 0.10). The overall RRR was 0.86 (SD = 0.10). For the lateral incisors all RRRs were statistically significant. For both the lateral and central incisors, the RRR was not significantly different during the torquing phase, indicating that, in this sample, the torquing stage did not causing more root resorption than the first stage of treatment.
CONCLUSION: Using the Tip-Edge technique, root resorption of both the central and lateral incisors occurred to some extent, as with other techniques. However, there was no statistically significant difference in RRR during the first stage of treatment compared with the RRR during the torquing phase.

73 COMPLICATIONS DURING MANDIBULAR MIDLINE DISTRACTION

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AIM: To analyse the number and type of complications after mandibular midline distraction.
MATERIALS AND METHOD: The records of 56 consecutive patients (aged 11-51 years) who had undergone mandibular midline distraction alone (n = 13) or combined with rapid maxillary expansion (n = 43) were evaluated. The distractors used were all tooth-borne. If complications occurred during treatment, these were recorded.
RESULTS: Eight patients (14 per cent) had complications after the mandibular midline distraction. In two subjects (25 per cent), the screw of the distraction appliance rotated back between the activations, in another two (25 per cent) scar strictures developed, in three cases (37 per cent) the osteotomy had to be repeated because the symphysis did not open, and in one subject (13 per cent) a lower incisor fractured.
CONCLUSIONS: The development of scar strictures and an unstable screw, were both minor complications. Only four of the 56 patients (7 per cent) had serious complications and three of these were corrected by repeating the osteotomy. However, one patient had irreversible damage due to a fractured tooth.

74 TISSUE ENGINEERED MUCOSAL SUBSTITUTES IN THE DOG PALATE

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AIM: Tissue shortage complicates surgery in cleft lip and palate anomalies. The healing of defects in the palate impairs growth of the dento-maxillary complex due to scar tissue formation. Implantation of grafts into the wound area might reduce this adverse effect of surgery. The aim of this study was to evaluate a cultured mucosal substitute, which can be used as a graft material.
MATERIALS AND METHOD: Two different types of cultured mucosal substitutes composed of skin-derived substrates (unprocessed dermis and AlloDerm) and autologous oral keratinocytes were implanted in palatal wounds in six dogs. The animals were sacrificed 1, 3, and 12 weeks after surgery. The inflammatory response, ingrowth of (myo-)fibroblasts, and the formation of a basal membrane on haematoxylin and eosin stained sections and by immunohistochemistry were evaluated.
RESULTS: Prior to implantation, all cultured substitutes possessed a multilayered epithelium, closely resembling palatal epithelium. After implantation, however, the epithelium was lost and an inflammatory response was observed in the first week. After 3 and 12 weeks, the implanted substitutes had completely disappeared and epithelial migration had occurred from the wound

margins.
CONCLUSIONS: Mucosal substitutes, composed of a skin-derived substrate and autologous keratinocytes, do not improve the healing of palatal wounds. It is suggested that the revascularisation of the wound area is too slow to allow survival and integration of the substitutes.

75 LONG-TERM CONSEQUENCES OF ORTHODONTIC ROOT RESORPTION

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AIM: To evaluate long-term stability of tooth position and status of teeth in patients who experienced severe root resorption during orthodontic treatment and to compare them with patients who developed only minimal resorption.
MATERIALS AND METHOD: Pre-treatment (T1), post-treatment (T2) and post-retention (T3) panoramic radiographs of 178 patients who had completed fixed appliance therapy at least 9 years previously were screened for root resorption in the upper incisor area using Malmgren's 5-point ordinal scale. A case-control study was performed. Thirty-two patients with severe root resorption (scores 3 and 4, group 2) were matched with patients with minimal root shortening (scores 0 and 1, group 1). Upper anterior tooth position was scored on study casts using Little's Irregularity Index. In 15 patients in each group, tooth mobility was measured at T3 with the Periotest device.
RESULTS: Root resorption: During treatment the scores increased (T1: number of roots with score 0 = 242; score 1 = 14; T2: score 0 = 52; score 1 = 76; score 3 = 113; score 4 = 15). There was no apparent change after treatment. Irregularity Index: No significant intergroup differences were noted (median T1: 3.6 versus 4.1; T2: 1.4 versus 1.5; T3: 2.4 both groups). Periotest: Group 1: mobility of all incisors was normal. Group 2: 12 incisors in five patients had slightly higher values (all teeth had a resorption score of 4). However, intergroup differences were not statistically significant. Correlation root resorption/Periotest: Only the upper left lateral incisors showed significant correlation between root resorption score and Periotest value ($r = 0.35$, $P < 0.05$).
CONCLUSIONS: There was no apparent progression of root resorption after active treatment. Stability of tooth position was not impaired in subjects with severe resorption. Increased tooth mobility may be possible in extreme cases, but only to a moderate amount. Many years after orthodontic treatment, teeth with severe root resorption have stability that is comparable with those teeth exhibiting only minimal resorption.

76 MINI PIGS AND MICRO-SCREWS**

D Wiechmann[1], A Berens[2], A Büchter[3], [1]Medical School Hannover, [2]Private Practice, Hannover, [3]ZMK Klinik der WWU, Münster, Germany

AIM: To obtain information about the general behaviour of micro-screws after loading with orthodontic forces.
MATERIALS AND METHOD: Over 200 micro-screws from two different manufacturers were placed in the mandibles of seven mini pigs and loaded with continuous forces from 50 to 500 cN.
RESULTS: (i) Osseointegration was achieved, even after immediate loading with higher forces; (ii) Failure rates were in general low; (iii) The distance from force application level to bone level was an important factor for stability; (iv) Osseointegrated micro-screws with polished surfaces were easily removed.
CONCLUSIONS: In this animal study, micro-screws have shown to be an effective anchorage tool. However, before placement, the individual situation has to be carefully examined, in order to choose the most appropriate screw (length, diameter, head) and force.

77 THE ROTTERDAM PALATAL DISTRACTOR FOR WIDENING A NARROW MAXILLA: AN ANALYSIS OF THE FIRST 25 PATIENTS

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Netherlands

AIM: Transverse maxillary hypoplasia (TMH) is frequently seen in syndromal and non-syndromal patients and this can be corrected by means of surgically assisted rapid maxillary expansion. The distractors can be tooth- or bone-borne. The purpose of this study was to evaluate the use of the Rotterdam Palatal Distractor (RPD), a bone-borne device, based on the principle of a car-jack.
SUBJECTS AND METHOD: Between September 2003 and November 2004, 20 patients with TMH were treated with the RPD. Eleven syndromic patients (4 with Aperts syndrome, 1 with Pfeiffer's syndrome, 1 with frontonasal dysplasia and a midline cleft, 1 with osteopathia striata and 4 cleft patients) and 14 non-syndromic patients were included. The RPD was positioned with the plates on the bone over the roots of the first or second premolars. Distraction was started according to the protocol, until the desired distance was reached. The distractor was removed after a 3-month consolidation period.
RESULTS: In all 25 patients, the distractor functioned successfully and the desired expansion was achieved. In one cleft patient with an extremely low palate the distractor lost stability after reaching the expansion and had to be removed. With an orthodontic transpalatal bar the expansion was still consolidated. In eight patients the activation rod moved out of the midline without clinical consequences.
CONCLUSION: This bone-borne RPD is easily placed, activated and removed. No screw fixation (with possible damage to the roots) is necessary. The RPD is especially useful in syndromic patients with totally collapsed maxillary segments and no space for tooth-borne appliances.

78 ASSESSMENT OF THE CELL CYCLE IN THE CONDYLE USING MICROARRAY TECHNOLOGY

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AIM: Mechanical strain produced by mandibular advancement has been linked to condylar growth. A close correlation exists between replicating mesenchymal cells and condylar growth. However, the factors regulating such a process have not yet been identified. The aims of this study were to investigate the expression profile of cell cycle genes in the mandibular condyle during natural growth and upon mechanical strain, to identify those key regulatory genes, and to quantify their expression intensity.
MATERIAL AND METHODS: Two hundred and eighty 35-day-old female Sprague-Dawley rats were randomly divided into seven experimental and seven control groups. The experimental groups were fitted with bite-jumping appliances. Each group of rats was sacrificed on the following experimental days: 1, 3, 7, 9, 14, 30 and 33. Total RNA was extracted from condylar cartilage for oligonucleotide microarray analysis. Validation was undertaken by RT-PCR and immunolocalization to determine the protein distribution in the condylar cartilage.
RESULTS: Thirty-nine known cell cycle genes were present in the condyle, where Cyclin D1, PCNA and Wnt5a were found to be differentially expressed. RT-PCR confirmed that Cyclin D1 reached a 2-fold increase on day 1 and a 3-fold increase on day 14 of advancement, whereas Cyclin D1 shortened the G1 phase of the cell cycle and accelerated entry into the S phase. PCNA showed a 2.2 fold increase on both experimental days 9 and 30 to facilitate the replication of mesenchymal cells during the S-phase. Wnt5a showed a 2-fold increase on experimental day 1, which helped to recruit replicating mesenchymal cells into the chondrogenic lineage.
CONCLUSION: Changes in the biophysical environment of the temporomandibular joint produced by mandibular advancement trigger a cascade of events that leads to a significant increase in cellular proliferation leading to condylar growth through Cyclin D1, PCNA and Wnt5a pathway.

79 SECULAR CHANGE IN JAPANESE STANDARDS: A CEPHALOMETRIC ANALYSIS**

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AIMS: To compare the cephalometric values from the study of Iizuka (1957), widely used as standard for Japanese populations, with those obtained from Japanese normal occlusion subjects, and to examine whether there is a secular trend in the Japanese profile.
SUBJECTS AND METHOD: Seventy-one Japanese adults with normal occlusion who were born between 1950 and 1961 (33 males, 38 females). After tracing the cephalograms, 18 cephalometric variables were calculated and compared with Japanese normal occlusion subjects, including Iizuka's sample.
RESULTS: The means of the *y*-axis and interincisal angle in the present sample were significantly smaller, and L1 to the mandibular plane angle was significantly larger than in Iizuka's sample, both for males and females. SNA, SNB and U1 to SN plane angle were significantly larger for males, and the facial plane angle was significantly larger for females. The mandibles of the present subjects were positioned more anteriorly and the incisors showed stronger labial inclination than Iizuka's sample. According to Iizuka, the Japanese subjects had a posteriorly positioned mandible, a larger mandibular plane angle, and protruded incisors compared with Caucasians. The profile of the present sample had skeletally more resemblance to Caucasians.
CONCLUSIONS: After the Second World War, a westernized life style became popular in Japan, which has resulted in changes in the Japanese body size and proportion. A secular change was also found in the facial region in the Japanese. When differences in life style or eating habit among different ethnic groups diminish, the variation in dentofacial structure may also decrease.

80 A NOVEL PHOTOGRAPHIC ANALYSIS DEMONSTRATING THAT LABIAL APPLIANCES HAVE NO EFFECT ON LIP PROMINENCE

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AIMS: To establish a new soft tissue analysis performed by computerized tools, using photographs, and to assess changes in the lips following debonding of labial appliances using this analysis.
MATERIALS AND METHOD: Profile photographs of 33 patients taken just before debonding of labial brackets and immediately after completion of the debonding procedure (less than 30 minutes). The photographs were taken in a standardized manner with a digital camera while the patients were instructed to keep their teeth and lips in light contact. Each photograph was analyzed twice using a customised analysis and Viewbox™ software. In order to check the error of the method, a preliminary study was conducted in which nine patients were photographed twice at a 30-minute interval, without undergoing any treatment procedure. A reference line was constructed between the centre of tragus and outer canthus. The point where the elongation of this line intersected with the profile was called 'nasion-modified' and served as the vertex point for the angles used to evaluate the prominence of the lips. Angles were constructed from lines derived from the following landmarks: Upper lip: subnasale, point A and labrale superius. Lower lip: labrale inferius, point B and pogonion. The final position of the lines was determined when they were tangent to the appropriate landmarks. ANOVA and *t*-tests for paired differences were used.
RESULTS: The reproducibility of this photographic analysis was confirmed in the preliminary study, as no significant differences were found between the measurements ($P < 0.05$). No statistically significant differences were found in lip prominence between the pre- and post-debonding photographs ($P < 0.05$).
CONCLUSIONS: This novel photographic analysis method can be used to assess profile changes. The presence of bonded labial appliances has no effect on lip prominence.

81 INTEGRATING PERIODONTICS WITH ORTHODONTICS FOR MANAGING PATIENTS WITH PERIODONTAL PROBLEMS

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AIM: The management and reconstruction of 'pink aesthetic', the hard and soft tissues surrounding teeth, becomes more of an issue for today's clinicians. The presence or absence of the interdental papilla depends upon the distance between the contact points to the crest of the alveolar bone. The loss of interdental papilla can lead to cosmetic deformities, phonetic problems and lateral food impaction. Although several procedures have been proposed for surgical reconstruction of the interdental papilla, the reconstruction of atrophied or even partial loss of interproximal papilla height is difficult. The purpose of this clinical study was to evaluate the interdental papilla following a combination of periodontal regenerative therapy for the treatment of intrabony defects and orthodontic treatment.
SUBJECTS AND METHOD: Twenty-five patients with deep intrabony defects treated using demineralized freeze-dried bone allograft and collagen barriers. After six months, post-surgical interproximal stripping of the coronal parts of the involved teeth and orthodontic tooth movement of the teeth was performed to relocate the contact points more apically. Clinical parameters, which included the papilla index, clinical attachment level, pocket depth, gingival index and plaque index, were recorded at baseline, and 6 and 12 months post-surgically.
RESULTS: There was a significant improvement in all clinical parameters 12 months post-surgery with complete arrest of the periodontal disease progression.
CONCLUSION: Combined periodontic-orthodontic therapy resulted in the formation of a new contact area between the two adjacent teeth and in a normalized distance between the contact point and the crest of the bone. All of these factors guided and created the presupposing conditions for the reconstruction of the papillae.

82 A COMPARISON OF ANCHORAGE SYSTEMS ON THE VERTICAL DIMENSIONS IN EXTRACTION CASES

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AIM: To evaluate and compare the vertical dimension changes that occur with different anchorage systems in extraction cases.
SUBJECTS AND METHOD: Twenty-six subjects with an Angle Class I malocclusion (24 females, 2 males), treated with four premolar extractions and Begg mechanics. After mandibular local structural superimposition, the subjects were divided into two groups as moderate and maximum anchorage (2-4 mm mesialization = moderate anchorage, n = 14, 0-2 mm mesialization = maximum anchorage, n = 12). The ages ranged from 10.33-20.00 years (mean 14.05 years), 13.33-23.33 years (mean 16.96) in the moderate and maximum anchorage groups, respectively. The SN/GoGn angles were 36.31 and 41.83 degrees initially in the moderate and maximum anchorage groups, respectively. Only intermaxillary Class II and intramaxillary elastics were used. No extraoral anchorage mechanics were employed during the treatment periods.
RESULTS: In the moderate anchorage group, *y*-axis angle ($P < 0.01$), AFH, UAFH, LAFH, PFH, occlusal plane angle, interincisal angle, upper incisors perpendicular to the palatal plane, and lower incisors perpendicular to the mandibular plane angle were increased ($P < 0.001$). U1/PP and L1/MP were significantly decreased ($P < 0.001$). In the maximum anchorage group, LAFH and interincisal angle ($P < 0.05$), lower molar perpendicular to mandibular plane ($P < 0.01$), and upper incisor perpendicular to palatal plane ($P < 0.001$) were significantly increased. U1/PP and L1/MP were significantly decreased ($P < 0.05$). When the treatment changes between the moderate and maximum anchorage groups were compared, UAFH, PFH, occlusal plane angle ($P < 0.05$), and the lower molar perpendicular to mandibular plane ($P < 0.001$) were found to be significantly different.
CONCLUSION: No significant difference was found in the vertical dimensions between the

moderate and maximum anchorage group. The vertical height measurements remained stable in both groups contrary to what was anticipated.

83 APPLICABILITY OF DENTAL AND SKELETAL AGE ASSESSMENT METHODS IN A SAMPLE OF SAUDI CHILDREN: A PRELIMINARY REPORT

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AIM: To test the applicability of western dental age and skeletal assessment standards in a sample of Saudi children. An attempt was made to find the interrelationship between the obtained dental and skeletal ages, together with the actual chronological age of the same sample.
SUBJECTS AND METHOD: Sixty healthy Saudi children (30 boys, 30 girls) with an age range of 6-12 years (mean 9.4 years). Panoramic and left handwrist radiographs were obtained and a clinical examination was undertaken to record the erupted teeth. Dental age estimation was performed according to two methods; the first according to Demirijian where dental maturity was measured from the panoramic radiographs and the second according to Kronfeld's tables of tooth eruption. Skeletal age was determined from the hand wrist radiographs according to Greulich and Pyle.
RESULTS: Thirty per cent of boys had dental maturity below the 10th percentile while in girls 16.7 per cent were below the 10th percentile and 10 per cent above the 90th percentile. Dental age corresponded to chronological age, 53 and 50 per cent for boys and girls, respectively. All boys had delayed skeletal development, while in girls skeletal development was within normal range in 40 per cent.
CONCLUSION: Dental age estimation by both methods was not accurate for Saudi children. Skeletal age estimation did not correspond to either dental or chronological age. Girls showed more advanced skeletal and dental development than boys.

84 EVALUATION OF THE PUBLISHED TREATMENT EFFECTS OF FUNCTIONAL APPLIANCES OR EXTRA-ORAL TRACTION IN CLASS II MALOCCLUSION

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AIM: To evaluate and compare treatment efficiency following therapy with functional appliances or extra-oral traction (EOT), based on data published in the literature.
MATERIALS AND METHOD: A literature search was performed to identify articles from 1991 to 2004 reporting treatment of Class II malocclusions using functional appliances or EOT, as well as untreated control groups of Class II malocclusion individuals. The articles included in the study described cephalometric values on treatment or growth changes of these individuals. From the identified studies, changes in SNA, SNB, ANB and overjet were analysed. Mean change, variance, and coefficient of variance values were calculated and used for statistical comparison.
RESULTS: Twenty-seven suitable studies were identified and the data were analysed. A significant reduction in mean SNA changes was found for the EOT group when compared with the functional appliance group ($P < 0.03$). There was no statistically significant difference in the increase in SNB for the two groups, but the functional appliance group demonstrated a significantly larger variation for SNB changes during treatment ($P < 0.05$). No statistically significant changes were observed for ANB. The reduction in overjet was larger for the functional appliance group ($P < 0.003$) but this group also revealed a significantly bigger variance value in the treatment effect ($P < 0.005$).
CONCLUSIONS: The treatment efficiency of functional appliances versus EOT in the management of Class II malocclusions is currently often neglected. Instead, preference is given exclusively to the cited values of mean change obtained in clinical studies. However, large between-patient variation and small mean changes are usually observed. The findings of the present study suggest that functional appliances lead to a larger change as far as SNB and overjet are concerned but with a concurrent larger variance in the treatment response of the individuals.

85 EFFECTS OF MANDIBULAR SYMPHYSEAL DISTRACTION ON THE POSITION OF THE CONDYLE: A PRELIMINARY REPORT

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AIM: To investigate the effects of mandibular symphyseal distraction osteogenesis (MSDO) on the intercondylar angle, intercondylar distance and intergonial distance by means of three-dimensional computerized tomography (3D CT).
SUBJECTS AND METHOD: Seven patients (5 females, 2 males) between 15 to 17 years of age, who had undergone MSDO. Distraction was accomplished with a hybrid appliance (tooth- and bone-borne), which consisted of a Hyrax-type distractor placed between the right and left first mandibular premolar teeth and labial bony surface of the mandibular symphysis. Before placement of the distractor, 3D CT scans were taken of all patients. All distractions were carried out at a rate of 1 mm per 24 hours. The amount of distraction was 7 mm for each patient. 3D CT scans were also taken after distraction. Angular and linear measurements were undertaken using 3D CT records, and compared with Wilcoxon's test at the 95 per cent confidence level.
RESULTS: Statistically significant differences were found between the values measured before and after MSDO for intercondylar angle ($P = 0.018$), intercondylar distance ($P = 0.028$) and interramal angle ($P = 0.026$). The angle and distance between the right and left condyles was increased by MSDO.
CONCLUSION: MSDO has a disto-laterally rotating and laterally displacing effect on the mandibular condyle in the glenoid fossae.

86 PALATAL DISPLACED CANINES: A GENETIC OR AN ACQUIRED DISORDER?

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AIM: The disagreement referring to the genetic or acquired aetiology of palatally displaced canines (PDC) has not yet been solved. Some authors have linked reductions in the number and size of certain teeth with the occurrence of PDC. This fact, together with the presence of an increased family frequency and arch space adequacy, are the main factors that are consistent with a genetic aetiology. However, canine displacement is presumed by others to be an acquired disorder. The aim of this study was to determine the mesiodistal crown size of the maxillary upper incisors in unilateral and bilateral PDC patients and to compare the findings with those of a control sample.
MATERIALS AND METHOD: Pre-treatment dental casts of consecutively treated orthodontic patients with one or both PDC (n = 98, 71 unilateral and 27 bilateral). This PDC sample was matched according to age and gender with the pre-treatment dental casts from orthodontic patients with physiological canine eruption. For both groups the maximum mesiodistal crown diameters of the four upper incisors were recorded in millimetres and compared. In addition, the left and right sides of each patient were compared in unilateral cases. Interexaminer reliability was assessed using a quadruple determination method. Statistical analysis was performed using ANOVA or *t*-tests for quantitative variables comparison.
RESULTS: There was no significant difference between the mesiodistal size of the upper incisors in the PDC patients or controls. The mesiodistal size of the upper incisors in the affected and unaffected sides of unilateral PDC did not show significant differences.

87 HISTOLOGIC EVALUATION OF IMPLANT ANCHORS IN THE MEDIAN PALATAL SUTURE OF GROWING DOGS

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AIM: To evaluate possible repair processes in the median palatal suture in growing dogs after insertion and loss of orthodontic implant anchors (OIA).

MATERIALS AND METHOD: Three growing beagle dogs each received an orthodontic implant anchor (Orthosystem®, Straumann, Waldenburg, Switzerland) in the median palatal suture at the level of the second premolars. One dog did not receive any implant and served as the control. All animals were subjected to a scheme of sequential point labelling with vital stains every 6 weeks. After 6 months, the dogs were sacrificed and sections of the insertion sites were made and prepared for histological evaluation.
RESULTS: During the first 6 weeks of the examination period, two of the implants were lost. In the control dog, an intact 'Y-shaped' suture was observed, consisting of loose cell rich connective tissue, with numerous fibroblasts and some vessels. Fibres could also be observed. Where the implant was still in place, there appeared to be some bone loss around the implant, and the suture was enlarged. In the two dogs where the implants were lost, a repair process of the bone was observed, especially on the palatal side. In these dogs the suture also consisted of loose connective tissue, but the number of fibroblasts was diminished and an invasion of soft tissue, probably originating from perforations to the nasal mucosa, could be observed.
CONCLUSIONS: When the median palatal suture has been disturbed by insertion of implants, after the implants are removed, a slow repair process of the bone can be observed starting from the palatal side. The suture itself did not contain as many fibroblasts as seen in the control dog. It should be stressed that, because of the small number of specimens evaluated, conclusions are not definitive. Further studies are needed.

88 THE IMPORTANCE OF USING POSITIONING JIGS FOR ORTHODONTIC BRACKET BONDING

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AIM: To compare the accuracy of bracket placement (Tip-Edge and Edgewise) with and without the help of positioning jigs, and to test both bonding procedures between practitioners with different levels of experience.
SUBJECTS AND METHOD: Fifteen clinicians divided into three groups according to their clinical experience (none, moderate and significant). Each clinician was asked to bond the brackets of two fixed orthodontic techniques (Tip-Edge and Edgewise) in two sessions: (1) to bond the brackets using positioning jigs (2) to bond the brackets without the help of positioning jigs. The *in vitro* study was carried out on a phantom-head containing an upper and lower frasaco-dentition (20 teeth) simulating a clinical situation. After bonding of a specific bracket system, standardized digital photographs were taken of each tooth. Two points were digitized to determine the exact position of the bracket on the tooth: height, mesio-distal position and angulation. These values were compared with a 'gold' standard.
RESULTS: The use of positioning jigs during bonding resulted in a more consistent vertical placement of the bracket in the three clinician groups. A large variability in the mesio-distal position of the brackets for the two appliances with or without the use of jigs was found. For the mesio-distal positioning there was no statistically significant difference between the three groups of clinicians. There was a tendency to place the brackets without jigs more gingivally on the lower canines. There was a significant difference in the angulation of the Tip-Edge bracket on the upper canines between both procedures (with and without jigs).
CONCLUSION: The use of positioning jigs is important in the vertical placement of brackets, while for the mesio-distal position of the bracket, each clinician seems to have his/her own favoured bracket position.

89 IMPLANT SUPPORTED MOLAR DISTALIZATION BY EXPANSION SCREW

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AIM: To determine the effects of a new designed intra-oral molar distalization device supported with

a palatal implant.
SUBJECTS AND METHOD: Ten patients (5 males, 5 females, mean age of 17 years 8 months) with a Class II occlusal relationship. A stepped screw titanium implant (4.5 mm diameter × 8 mm length), was placed in the palatal region for anchorage purposes. A surgical template containing a metal drill housing was prepared for placement of the implant. After three months of healing, the implant was osseointegrated and molar distalization was undertaken using a mini expansion screw against the implant anchorage. The patients were instructed to turn the screw twice a week (1/2 turn) and activation was continued until the achievement of a super Class I occlusal relationship. The status was retained with the same screw kept in position for approximately 2-3 months. Lateral cephalometric, panoramic films and models were obtained before and after distalization.
RESULTS: The upper first molars were distalized, on average, 4.5 mm ($P < 0.05$), which was also supported by model measurements; upper right molar 4.5 mm ($P < 0.05$) upper left molar 5.1 mm ($P < 0.05$). Upper second premolars followed the first molars with a value of 3 mm ($P < 0.05$). Tipping of the molars, measured on the panoramic films, was also observed. Although the devices were activated by the same amount, distalization values were higher on the left side, which may be related to the implant site that was the left side for all patients (except one).
CONCLUSION: This method can be used effectively to achieve distalization of molars with concomitant movement of premolars without anchorage loss.

90 INFLUENCE OF AGEING WITH LACTIC ACID ETCHING ON THE BOND STRENGTH OF BRACKETS

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AIM: In an earlier investigation (Ayad *et al.,* 1996,) it was shown that lactic acid has an etching effect on both enamel and dentine and the possibility of substituting lactic acid for phosphoric acid as an enamel and dentine conditioner might be considered. The aim of this study was to determine the effect of lactic acid ageing at various concentrations and etching times on the shear bond strength (SBS) of brackets bonded with the resin orthodontic adhesive system (Transbond XT).
MATERIALS AND METHOD: Thirty human premolars divided into five groups (n = 5); the remaining five teeth were prepared for electron microscopy. Group I, 37 per cent phosphoric acid/Transbond XT; group II, 10 per cent lactic acid/Transbond, and group III, 20 per cent lactic acid/Transbond. The etching time was 30 seconds. In groups IV and V, 20 per cent lactic acid/Transbond XT was used with 20 and 30 seconds etching time, respectively. SBS was measured with a universal testing machine at a crosshead speed of 0.5 mm/minute.
RESULTS: The micrographs revealed that lactic acid etched the tooth enamel in a manner similar to that of phosphoric acid. The SBS of enamel treated with 10 per cent lactic acid (122.1 ± 6.8) and 20 per cent lactic acid (118.7 ± 7.9) for 30 seconds were significantly higher ($P < 0.05$). However, the mean SBS for phosphoric acid was intermediate (81.6 ± 7.5).
CONCLUSION: Lactic acid could be used in place of phosphoric acid as an enamel etchant and may present less risk of adverse reactions *in vivo*.

Ayad M F, Rosenstiel S F, Farag A M 1996 A pilot study of lactic acid as an enamel and dentin coinditioner for dentin-bonding agent development. Journal of Prosthetic Dentistry 76: 254-259

91 SUCKING HABITS AND FACIAL DIVERGENCE IN ANTERIOR OPEN BITE SUBJECTS: A PREVALENCE STUDY

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AIM: To test the hypothesis that sucking habits and/or a hyperdivergent facial pattern contribute to

the development of an anterior open bite (AOB) in mixed dentition patients by means of a prevalence study on a large orthodontic population.
MATERIALS AND METHOD: The records of 1710 subjects in the mixed dentition were analyzed. The presence of sucking habits was registered along with the diagnosis of a low, normal, or high angle facial relationships through the use of SN-GoGn and FMA angles. An AOB was defined as a degree of overbite less than 0. Chi-squared tests ($P < 0.01$) were used for the statistical evaluation of prevalence rates.
RESULTS: A total of 586 subjects (34 per cent) presented with sucking habits, while 432 subjects (38 per cent) had a hyperdivergent facial pattern. A significant relationship was found between an AOB, facial divergence, and sucking habits. The presence of facial hyperdivergence was significantly associated with the development of an AOB both in subjects with and without sucking habits (prevalence rate for an AOB in hyperdivergent subjects was ×4 greater than in normal/hypodivergent subjects).
CONCLUSION: Persistent sucking habits are able to increase significantly the prevalence rate of an AOB in subjects both with low/normal and high values of facial divergence (3 times more than non-sucking subjects).

92 SOME CHARACTERISTICS OF THE MEROVINGIAN MANDIBLE
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AIM: To evaluate the shape of the mandible in a sample of Merovingian individuals.
MATERIALS AND METHOD: Sixteen human mandibles from the Merovingian period (V to VIIth century) originating from the site at Bourogne (eastern France) were prepared, examined, measured and radiographed using a standard cephalometric technique.
RESULTS AND CONCLUSIONS: Many characteristics of the human modern mandible were present in the Merovingian population. Tooth loss was frequent as well as decay and periodontal problems. Occlusal surfaces and contacts points between the teeth were heavily worn, with an important reduction of the mesiodistal dimensions of the crowns and reduction of arch length. No posterior crowding was seen and the third molars had erupted into a good position in all subjects. Inflammatory resorption of alveolar bone was observed for one single third molar. Crowding of the anterior teeth was commonplace. Craniometric measurements for the Merovingian (mandibular index = 85.8, gonio-condylian index = 83) were closer to Asian standards than Europoid norms. Cephalometric values for the mandible in the study group did not differ from a homologous adult control group for the variables gonial angle, corpus length, and overall mandibular size. The only difference was a more developed ramus height in Merovingian individuals ($P < 0.05$).

93 PEER ASSESSMENT RATING IN PATIENTS FROM A UNIVERSITY SPECIALITY COURSE
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AIM. To evaluate the orthodontic benefit to patients treated by students attending the university speciality course in Strasbourg, France.
SUBJECTS AND METHOD: The study group comprised patients to be presented for the qualification of specialist in orthodontics. All had been treated with fixed appliances in both arches.
RESULTS: Seventy-four girls and 38 boys were enrolled in the study. After a second scoring of 15 cases, Kappa test for the beginning and end of treatment were 0.44 and 0.83, respectively, making the method acceptable. Thirty five per cent had teeth extracted. Twenty nine per cent were Class I, 66 per cent Class II and 5 per cent Class III. On average treatment lasted 25 month. The mean Peer Assessment Rating (PAR) score at the beginning of treatment was 24.4. A difference existed between the Class I (18.7), Class II (26.2), and Class III (33.3) subjects ($P < 0.05$). The mean PAR end score was 1.2 (no significant difference between subgroups). The mean PAR-reduction was 23.2 (18 in

Class I, 25 in Class II, and 32 in Class III ($P < 0.05$ between the subgroups). The mean PAR percentage was 94 (no difference between the subgroup). Fifty-three per cent of the patients were 'greatly improved', 46 per cent 'improved' and 1 per cent unchanged or worse. Treatment length was not correlated with PAR beginning, end, reduction or percentage reduction. Multiple regression analysis showed that none of the components of the index were predictive for treatment length. No gender difference could be seen.
CONCLUSION: The cases presented by the students at the end of their specialist tuition did not show a very high PAR beginning, but PAR end was very weak. The morphological interarch relationship at the end of treatment was good and great attention was given to reach this result. Treatment length correlated to the severity of the cases as rated by PAR or its components.

94 CHANGES IN THE BUCCAL ALVEOLAR BONE OF MANDIBULAR PERMANENT INCISORS AFTER ORTHODONTIC THERAPY WITHOUT EXTRACTIONS

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AIM: To determine morphological changes in the buccal alveolar bone of the mandibular permanent incisors after two-phase orthodontic therapy.
MATERIALS AND METHOD: Cephalometric radiographs of 47 subjects (17 males, 30 females) mean age 11.2 years, were examined after the second phase of orthodontic treatment without extractions. The treated group (TG) was compared with an untreated control group (CG) of 47 subjects (21 males, 26 females, mean age 10.9 years). Several measurements were calculated on latero-lateral cephalogram in order to evaluate IMPA angle inclination and changes in the buccal alveolar bone. Descriptive statistics, including means (m) and standard deviations (sd), were calculated for each group; a parametric study and a Pearson test were used for correlations. The means of the two groups were studied by a Student's *t*-test.
RESULTS: After 12 months of therapy the TG showed: very good control of lower incisor inclination (IMPA m = 0.77, sd = 4.97, $P = 0.296$); a significant increase of MI-D (m = 2.14, sd = 2.13, $P = 0.000$); a significant increase of CA-D (m = 1.72, sd = 2.87, $P = 0.000$). After 12 months the CG showed: a significant increase of MI-D (m = 1.03, sd = 2.25, $P = 0.003$); a significant increase of CA-D (m = 0.97, sd = 2.47, $P = 0.010$). It was possible to observe a high correlation between MI-D in the TG and CG, and between CA-D in the TG and CG, i.e. a similar dental extrusion and a physiological increase of buccal alveolar bone in both groups.
CONCLUSION: Early two-phase orthodontic treatment allows a reduction in time of edgewise application with a very good control of IMPA angle and periodontal tissues.

95 LONG-TERM CEPHALOMETRIC RESULTS OF FRÄNKEL FUNCTIONAL REGULATOR TREATMENT OF CLASS II MALOCCLUSIONS

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AIM: To assess the long-term skeletal and dental changes following Fränkel functional regulator therapy (FR) in subjects with a Class II malocclusion.
SUBJECTS AND METHOD: Thirty-six Class II malocclusion patients (30 Class II division 1 and 6 Class II division 2) treated only with FR and without any retention. Pre- and short-term post-treatment radiographs, and in some cases after 7 or even 11 years, were available. Occlusal, facial and skeletal changes were analyzed through superposition of Na-Ba in Cc of the teleradiographs with the Nemoceph program (Nemotec Co, Spain).
RESULTS: There were significant changes in the inclination of the incisors and in the craniofacial complex, which remained for a long time. Changes in facial convexity (5.19 to 3.52 degrees), ANB (5.96 to 3.84 degrees), SNA (80.43 to 80.36 degrees), SNB (74.39 to 76.52 degrees), Wits appraisal (4.31 to 1.51 mm), maxillomandibular difference (19.96 to 24.81 mm), GoGn-SN (35.87 to 34.43 degrees for Class II division 1 and 25.45 to 21.16 degrees for Class II division 2) and interincisive

angle (120.57 to 125.86 degrees for Class II division 1 and 148.71 to 132.44 for Class II division 2).
CONCLUSION: There is a need for further research to establish the precise extent of dentofacial orthopaedics. The present results confirm the use of FR as an adequate orthopaedic system for the correction of Class II malocclusions skeletally, facially and dentally.

96 THE EFFECTIVENESS OF DENTAL ALIGNMENT BETWEEN SLOW FRICTION CONVENTIONAL LIGATED AND SELF-CLOSING BRACKETS

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AIM: To evaluate the effectiveness of dental alignment of two types of brackets [Damon II (Ormco) and Synergy SWLF (RMO)].
SUBJECTS AND METHOD: Eighteen patients in the young permanent dentition with a Class I (n = 10) and Class II (n = 8) malocclusion characterized by osteodental maxillary marked discrepancy (over –6 mm) with a high irregularity maxillary index (>12 mm) and right and left symmetry (difference in the irregular index <4). In each patient, Damon II brackets were placed in the maxilla (D side) in a hemiarch and Synergy SWLF on the other (S side). For all patients the only initial arch used was a round 0.014 inch nickel-titanium-copper wire, ligated closing the cover of the self-closing brackets and with low friction ligatures or wire ligatures on the central Synergy wings. Plaster dental models and standardized photographs were obtained before (T1), and without changing the arch at 6 (T2) and 12 (T3) weeks. The measurements were carried out using the Nemoceph program (Nemotec Co., Spain).
RESULTS: A progressive decrease in the dental irregularity index was observed in all patients. The most important decrease was localized at the canines (mean 8.4), followed by the lateral incisors (mean 7.01), central incisors (mean 3.34) and first and second premolars (mean 3.29). No significant differences were found between the D and S side at any of the time periods.
CONCLUSIONS: In spite of the limitations of the study, there were no significant differences between the effectiveness of alignment with self-closing brackets or low friction conventional ligated brackets.

97 BIOMECHANICAL EVALUATION OF CHIN CUP TREATMENT WITH DIFFERENT FORCES

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AIM: To evaluate the biomechanical effects of chin cup treatment using a three-dimensional finite element model (3D FEM).
MATERIALS AND METHOD: 3D FEMs of the mandible and temporomandibular joint were modelled and analyzed. The final mesh consisted of 1572 solid elements with 5432 nodes. A chin cup, with a force of 500 g, was applied in a direction from the chin toward the mandibular condyle and coronoid process, and the mechanical response in terms of displacement and von Mises stresses were determined.
RESULTS: The mandible was displaced forward and slightly downward for both force vectors. The mandibular condyle and coronoid process showed minimal displacement. The highest stress levels were observed at the condylar and coronoid regions for both force vectors.
CONCLUSION: The location of the force vector when treating patients with mandibular prognathism is highly dependent on appliance design.

98 OCCLUSAL CONTACTS OF DIFFERENT RETENTION PROCEDURES AND UNTREATED CONTROLS IN A ONE-YEAR FOLLOW-UP PERIOD

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AIM: To evaluate the number of contacts occurring in centric occlusion during a 12 month period with two different retention procedures, and comparison with a control group.
SUBJECTS AND METHOD: The occlusal contacts in 20 patients with a Hawley retainer and 20 patients with a maxillary Jensen plate with mandibular fixed retainers were compared with a control group of 20 normal occlusion subjects. Silicone based impression bites were used to record occlusal contacts. To evaluate the intra- and inter-group differences, paired and independent sample *t*-tests were performed.
RESULTS: The total and posterior combined (actual and near) contacts of the study groups increased during the 12-month retention period. In the Hawley group, the actual contacts on the second molars, near contacts on the premolars and total contacts on the first molar (all $P < 0.05$) and premolars ($P < 0.01$) showed a statistically significant increase. In the mandibular fixed and maxillary Jensen plate group, the number of actual contacts on the posterior segment was further increased. In this group, the actual contacts on the first molars ($P < 0.01$), second molars ($P < 0.01$), premolars ($P < 0.05$) and canines ($P < 0.05$); total contacts on the first ($P < 0.05$) and second ($P < 0.05$) molars showed increases that were statistically significant. During the observation period some slight occlusal changes were observed in the normal occlusion group, presumably due to the effects of growth and development. At the end of the study, during the 12-month observation period, no statistically significant occlusal contact differences were observed.

99 EFFECT OF SPLINTING METHODS AND FIXATION PERIODS ON ROOT DEVELOPMENT OF AUTOTRANSPLANTED IMMATURE THIRD MOLARS

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AIM: To assess the influence of the type and duration of splinting on final root length, root length increment, and mobility of autotransplanted immature third molars.
SUBJECTS AND METHOD: Sixty-three patients with a total of 65 transplanted immature third molars. All transplants had reached one-half (n = 29) to three-quarters (n = 36) of their expected root length. For 24 of the transplants, post-operative fixation was carried out with a rigid acid-etch composite and a wire splint for 4 weeks (rigid group), and in 41 transplants, with a suture splint for 1 week (suture group). All transplants were followed up clinically and radiologically for a mean period of 3.9 years.
RESULTS: Transplants in the rigid group revealed a significantly lower final root length ($P = 0.002$) and root length increase ($P = 0.001$) than those in the suture group. The differences were found to be more pronounced in transplants at earlier developmental stages.
CONCLUSIONS: Prolonged rigid fixation of autotransplanted immature third molars has a significantly negative influence on final root length and root length increment, especially in transplants at earlier developmental stages.

100 INFLUENCE OF ORTHODONTIC TREATMENT ON THE PULPAL CONDITION OF TEETH IN PATIENTS WITH MARFAN SYNDROME

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AIM: To determine the influence of orthodontic treatment on the pulpal condition of teeth in patients with Marfan syndrome.
SUBJECTS AND METHOD: Nineteen patients with Marfan syndrome (11 females, 8 males) aged 12-27 years (mean 18 years) who had been treated orthodontically with fixed appliances. The control group included 50 orthodontic patients (25 females, 25 males) aged 12-28 years (mean 17 years).

Pulpal condition was monitored clinically and radiographically before and after orthodontic treatment.
RESULTS: In the Marfan group signs of pulp obliteration were present in 27 per cent of the examined teeth before, and in 48 per cent of the teeth after orthodontic treatment (control group: 1 and 2 per cent, respectively; $P < 0.001$). After termination of orthodontic treatment signs of pulp necrosis were observed in 3 per cent of the teeth in the Marfan group and in 0.2 per cent in the control group ($P < 0.001$).
CONCLUSIONS: Orthodontic treatment of teeth in patients with Marfan syndrome increases the risk of pulp obliteration with subsequent pulp necrosis.

101 RAPID PALATAL EXPANSION AND MANDIBULAR SYMPHYSEAL DISTRACTION OSTEOGENESIS

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AIM: To investigate the effects of rapid palatal expansion (RPE) and mandibular symphyseal distraction osteogenesis (MSDO) on vertical skeletal structures.
SUBJECTS AND METHOD: Ten patients (8 females, 2 males) between 14 and 17 years of age who underwent RPE and MSDO procedures without extractions. Distraction was accomplished with a tooth-borne appliance which consisted of a Hyrax-type distractor placed between the right and left first mandibular premolar and molar teeth at the lingual side of the lower jaw. All distractions were carried out at a rate of 1 mm per 24 hours. The amount of distraction was 7 mm for each patient. Standardized lateral cephalograms were taken before treatment (T0), after RPE (T1), at the completion of MSDO (T2), and at the end of fixed orthodontic treatment (T3). Anatomical landmarks were traced on these radiographs and three angular and six linear parameters were measured. The data were evaluated by using a general linear model of repeated measures ANOVA and Wilcoxon's signed ranks test at the 95 per cent confidence level.
RESULTS: RPE significantly increased the vertical linear and angular skeletal dimensions (SN/MP, MP/PP, FMA, ANS/Me, N/Me, HRL/B, HRL/Pog), and decreased the overbite ($P < 0.01$). In other words, the difference between the T0 and T1 was statistically significant for all parameters except the distance from the horizontal reference line to menton (HRL/Me). Although the vertical parameters of the skeletal structures were decreased after MSDO (T2-T1), these differences were not statistically significant for FMA, N/Me, HRL/B, HRL/Pog, and HRL/Me.
CONCLUSION: Although MSDO decreased the vertical skeletal dimensions increased by RPE, this neutralizing effect was of equal magnitude.

102 MANUFACTURE OF DISTRACTORS USING THREE-DIMENSIONAL SOLID MODELS OBTAINED WITH THE STEREOLITHIGRAPHY TECHNIQUE

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AIM: To develop a method for the design and placement of distractors in patients with dentofacial anomalies. Three-dimensional (3D) stereolithographic solid models (SLA), which simulate the mandible, are used to determine the treatment type, to develop a customised distractor and the subsequent accurate placement of the mandibular distractors.
MATERIALS AND METHOD: The computed tomographic data of a patient with mandibular hypoplasia was rendered to a 3D data set with special software. A 3D solid model of the patient's skull was then prototyped on a stereolithograph machine (SLA250). Distraction screws were placed and adjusted to an appropriate position on the 3D solid model. The parallelism of the left and right distractors was adjusted by a parallelometer. After model surgery, the reliability of the distraction system was tested to verify the mechanical movement of the distractors and the lower jaw, by mounting the jaws on a simulator. The two distractors on both sides were engaged to a distractor guiding splint and the distractors carried to the patient with the same angulation and position as adjusted on the solid model. After the osteotomy and screw fixation, the acrylic splint was removed.

The position of the distractors was radiologically recorded.
CONCLUSION: 3D solid modelling using stereolithography allows realistic treatment planning and the design and manufacture of custom-made distractors.

103 THE ANTERIOR AND POSTERIOR COMPONENT OF FORCE

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AIM: An anterior component of force (ACF) linked to occlusal loading has been extensively discussed in the dental literature. The presence of a posterior component of force (PCF) has not yet been reported. The objectives of the present study were to define the presence of a PCF, to define the relationship between PCF and ACF, and to determine factors counteracting the adverse reaction of ACF, i.e. anterior crowding.
SUBJECTS AND METHOD: The ACF and PCF were assessed in 63 subjects aged 20-30 years by measuring the tightness of dental contact points (TDCP) in the lower jaw during biting on a bite fork. The TDCP of each contact point in one mandibular quadrant was measured once without occlusal loading and once while biting on the first premolar, second premolar and second molar with a constant bite force of 75 per cent of maximum bite force at the first premolar.
RESULTS: The results confirmed the presence of an ACF that dissipated at the lateral-canine contact point. The occlusal loading increased the TDCP of the loaded tooth by 78 per cent. PCF was also present but its magnitude was significantly (5-6 fold) less than that of the ACF.
CONCLUSIONS: ACF and PCF are physiologically in a state of imbalance. This condition is most likely related to the curve of Spee and the arrangement of the masseter muscle fibres. ACF/PCF imbalance is counteracted by ACF dissipation in a postero-anterior direction and canine blockage.

104 COMPARISON OF TREATMENT CHANGES IN OVERJET AND JAW BASE RELATIONSHIP WITH REMOVABLE AND FIXED FUNCTIONAL APPLIANCES

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AIM: To compare changes in overjet and jaw base relationship during treatment and follow-up of skeletal Class II malocclusion subjects.
MATERIALS AND METHOD: A series of lateral cephalograms obtained from a group of consecutive male patients treated with headgear-activator (RFA) for 12 months was compared with a matched group treated with a Herbst appliance for 6 months, followed by 'retention' with an Andresen activator for six months (FFA). The patients were then followed for a further 24 months. Lateral cephalograms were obtained at start of treatment, after 6 and 12 months of treatment, and after another 24 months, and analysed (Pancherz, 1982). Interpolations were made to obtain data representing exactly the same length of observations periods.
RESULTS. During the initial 6 months of treatment the jaw base relationship improved significantly more in the FFA than the RFA group; the difference of 1.5 mm being statistically significant ($P < 0.05$). After 12 months of treatment (RFA) and treatment and retention (FFA), there was no significant difference in the change of jaw base relationship between the two groups, and neither so at 24 months follow-up. After 6 months of treatment the overjet reduction was 5.7 mm greater ($P < 0.001$) in the FFA group than in the RFA group. At 12 months the RFA group showed a continued reduction in overjet whereas relapse occurred in the FFA group, the difference of 3.4 mm was statistically significant ($P < 0.001$). At the 24 month follow-up the difference in overjet change was 1.6 mm (ns).
CONCLUSION: The FFA seems to offer only short-term advantages with regard to changes in overjet reduction and jaw base relationship compared with the RFA. The observed superiority in the initial phase did not persist long-term.

105 FACIAL MORPHOLOGY OF NEOLITHIC, MEDIEVAL AND MODERN SKULLS
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AIM: To study craniofacial differences between three groups of skulls from three different historic periods (neolithic, medieval and modern).
MATERIALS AND METHOD: Three groups of skulls excavated in a region close to Lausanne, Switzerland. The first group, from the neolithic period comprised 27 skulls, 12 males and 15 females (estimated age: 23 to 67 years). The second group from the Middle Ages consisted of 25 skulls, 16 males and 9 females (estimated age: 18 years to mature adulthood). The third group from the modern period comprised 31 skulls, 23 males and 8 females (aged 16 to 59 years). Lateral radiographs were taken with the skulls positioned in the cephalostat and the mandible positioned as correctly as possible. The radiographs were then computerized and cephalometric analysis was performed. The sagittal relationship of the mandible was evaluated with caution because of the ambiguity of positioning the mandible in a correct position.
RESULTS: Comparison of the cephalometric morphology of the skulls of these three periods showed statistically significant difference between them. The mandibular plane angle to anterior cranial base (SN to GoMe) was larger in the modern than in the medieval group (P = 0.021) and larger in the modern than in the neolithic group (P = 0.015). No statistical differences were found between the neolithic and medieval groups. The modern skulls had larger interincisal angles, lower incisal angles and anterior face heights than the other two groups. The results suggest minor morphological vertical changes during 25 centuries when compared with the changes that occurred during the recent 5 centuries. These morphological alterations may be possibly related to changes in environmental factors.
CONCLUSIONS: The vertical craniofacial relationship has remained unchanged for many centuries. However, an increase in the vertical dimension has taken place during the last five centuries.

106 LONG-TERM STABILITY OF THE MANDIBULAR ANTERIOR SEGMENT
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AIM: To study the stability of the mandibular anterior segment at different stages after orthodontic treatment and to make comparisons between and within different subgroups of Angle Class I and Class II division 1 malocclusions.
SUBJECTS AND METHOD: One hundred and twenty three patients, with a mean pre-treatment age of 12.9 years. All patients had study models from four different stages: pre-treatment, post-treatment, post-retention and 10 years post-retention. Pre-treatment, the patients had either an Angle Class I or Class II division 1 malocclusion. They were divided into subgroups, based on the type of treatment: non-extraction, four premolar extractions, two premolar extractions in the maxilla and other extractions. All study models were assessed by the partial Peer Assessment Rating (PAR) score. Mean and standard deviation, in addition to range, were calculated for all subgroups at each treatment stage. An overall comparison between and within subgroups was performed using analyses of variance. Where an overall significant difference was detected, a comparison was carried out between subgroups at the different stages in addition to an inter-stage comparison for each subgroup.
RESULTS: For both Angle classifications, no overall significant difference between the subgroups and stages was detected; however there was an overall inter-stage difference within the subgroups. For both groups, the four premolar extraction subgroup had a higher pre-treatment partial-PAR score and showed a greater reduction during active treatment than the other subgroup. For the comparable subgroups, only the four premolar extraction subgroup maintained most of the treatment improvement up to the 10-year post-retention stage. All subgroups showed that the majority of the post-treatment changes occurred in the post-retention period.
CONCLUSION: Regardless of malocclusion, treatment decision and pre-treatment partial-PAR score, all subgroups ended with almost the same score 10 years post-retention. Stability of the

mandibular anterior segment can only be secured by permanent retention.

107 INHIBITION OF ORTHODONTIC TOOTH MOVEMENT BY CHEMICALLY MODIFIED TETRACYCLINE-3

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AIM: Orthodontic tooth movement requires extensive remodelling of the periodontal ligament (PDL) and alveolar bone. Osteoclasts are responsible for the resorption of bone, allowing the tooth to migrate in the direction of the applied force. Matrix metalloproteinases (MMPs) are essential for the degradation of the extracellular matrix of the periodontal tissues during remodelling. Chemically modified tetracyclines (CMTs) can inhibit MMPs, but lack antimicrobial activity. The aim of this study was therefore to analyse the effect of CMT-3 on the rate of orthodontic tooth movement in a rat model.
MATERIALS AND METHOD: Eighteen Wistar rats received an orthodontic appliance at the right side of the mouth according to the split-mouth rat model described by Ren *et al*. (2003). The rats were divided into three groups: groups 1, 2 and 3 were given a daily dose of 1 ml vehicle with 0, 6 and 30 mg/kg CMT-3, respectively, during 14 days. Orthodontic tooth movement was measured at days 0, 3, 7, 10 and 14. After sacrifice at day 14, histological sections were made. Sections were stained with haematoxylin and eosin and osteoclasts were detected with the ED-1 antibody.
RESULTS: There was a significant dose-dependent inhibition of tooth movement by CMT-3 (P = 0.037). Clear bone resorption was found at the compression side of the experimental teeth. In addition a significantly lower number of osteoclasts were found at the compression side of the 30 mg/kg group compared with the 0 and 6 mg/kg groups (P = 0.013).
CONCLUSION: CMT-3 has an inhibitory effect on the rate of tooth movement. This effect is probably due to the inhibitory effect of CMT-3 on MMP activity as well as on osteoclasts. CMT-3 seems to inhibit the recruitment of osteoclasts to the compression side.

108 AN INTERDISCIPLINARY APPROACH TO COMPLEX DENTAL CONDITIONS IN CHILDREN AND YOUNG ADULTS

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AIM: An interdisciplinary team of specialists in dentistry established at the University of Oslo provides services to the General Dental Service. The aim of the study was to investigate which conditions general dentists and specialists perceive as difficult to treat and therefore refer for interdisciplinary consultation and treatment planning.
SUBJECTS AND METHODS: From 1998 to 2003, 302 subjects (149 girls, 153 boys) with complex dental conditions were referred to the team at the Faculty of Dentistry. Dental pantomograms and extra- and intra-oral photographs were taken of all patients. The interdisciplinary team comprised an orthodontist, paediatric dentist, prosthodontist and oral surgeon who analysed and diagnosed the patients in order to establish a treatment plan.
RESULTS: The conditions were categorised into mild, moderate and advanced hypodontia (n = 124), traumatised and lost teeth (n = 113), disturbances in tooth development and eruption (n = 49), various anomalies (n = 40), disturbances in mineralization (n = 13), tumours/odontomas (n = 6) and temporomandibular joint problems (n = 10). Typical treatment plans for advanced hypodontia frequently included a combination of orthodontic treatment and osseointegrated implants. For children with missing anterior teeth due to trauma, a combination of autotransplantation and orthodontic treatment was indicated in some cases, while orthodontic space closure was given first priority in others. Severe amelogenesis imperfecta cases often needed prosthodontic restoration before orthodontic correction of the malocclusion could be initiated.
CONCLUSIONS: An obvious need appears to exist for organised interdisciplinary services for

complex anomalies and conditions in growing individuals. Interdisciplinary planning and treatment are required for high professional standards and success of outcome of such complex conditions. Emphasis on early diagnosis, careful treatment planning, co-ordination, and timing of different parts of the therapy are essential factors for a successful outcome.

109 BIOMECHANICAL EVALUATION OF DIFFERENT MINIPLATES IN THE FIXATION OF A FRACTURED HUMAN MANDIBLE

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AIM: To evaluate the biomechanical effects of positioning of different plates to achieve a stable fixation of a fractured mandible.
MATERIALS AND METHOD: A three-dimensional finite element model with a final mesh of 2514 solid elements with 4018 nodes was constructed. For this purpose, a fracture near the angle region of the mandible was evaluated and the fracture section was fixed to the bone with monocortical bone screws with a variety of five different commonly used miniplate combinations. New designs of miniplate systems were also developed and analyzed. The number, positioning, and design type of the miniplate systems were the main parameters. For correct bone healing, a stable fracture site is required during daily functioning of the mandible.
RESULTS AND CONCLUSION: Miniplates must not be placed only inferiorly. Single miniplates, if used alone, must be placed as high as possible. The most appropriate arrangement is the use of four-hole miniplate on the superior border and two-hole miniplate on the inferior positions.

110 A COMPARISON OF SEVEN DIGITAL SINGLE LENS REFLEX CAMERAS FOR ORTHODONTIC PHOTOGRAPHY

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AIM: Digital photography is widely used to document orthodontic patients. High quality intra-oral photography depends on the 'depth of field' focus and illumination. Automatic 'through the lens' (TTL) metering is ideal to achieve this at predetermined settings of the aperture. The aim of this study was to assess digital cameras in terms of: 1) Ease of use; 2) Quality of photographs; 3) Price.
MATERIALS AND METHOD: The cameras tested were single lens reflex and ring-flash capable. The ring flash and lens used were from the respective manufacturers. The Fuji S2Pro and Kodak DCSPro were tested with a Nikon ring flash and macro lens. Two sets of photographs were taken for each patient and compared on the same computer monitor. No alterations of the images were carried out. Two operators assessed the images for colour reproduction and resolution.
RESULTS: All the manufacturers claimed that their cameras were capable of TTL metering. Only the Olympus E1 and the Fuji S2Pro were able to fully utilise this at predetermined apertures (F22). Canon cameras were not able to fully operate TTL mode; the settings had to be manually adjusted. Nikon and Kodak cameras worked on manual settings only. All cameras produced high quality intra- and extra-oral images once adjusted. The main differences related to the quality of colour reproduction. The resolution of the images at maximum settings was more than satisfactory.
CONCLUSIONS: The Olympus E1 was easiest to use. This was followed by the Fuji, due to competitive price and better colour reproduction. All other cameras had to be manually set to produce satisfactory results.

111 A PROSPECTIVE STUDY OF BONDING: BOND-UP TIME, METHODS AND MATERIALS USED AND BRACKET FAILURE RATES

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AIM: Important determinants of efficiency of orthodontic treatment, which can be determined by the operator, are surgery-time used and the cost of the materials. Time for bond-up/repairs play a significant role in this equation and are thought to depend on the materials used. Most studies compare bracket failure rates of different bonding methods and materials, but do not correlate this to the time spent in bonding. The aim of this prospective longitudinal study was to assess the efficiency of bonding methods and materials by correlating bond time to failure rate.
SUBJECTS AND METHOD: Twelve experienced operators were asked to measure bonding time (pumice, etch, bond - until ready for archwire placement), record materials used, and their price. The amount of crowding, emergency appointments, archwires used, occlusal interferences, oral hygiene, patient co-operation and bracket failure were recorded. The study was terminated after two years.
RESULTS: N = 145 patients. Average bracket failure rate was 6.6 per cent with significant variation between operators. Premolar brackets were most likely to fail. Bracket failure occurred more often at the beginning of treatment and correlated positively to aligning wires. Bracket failure did not correlate with the amount of crowding at the beginning of treatment. Failure rate was very homogeneous between operators. There was a positive correlation for the time used for bonding and failure rate for some operators, but not others. There was no significant difference for the bonding time and the materials used. Bonding time was not significantly different between the majority of operators. Appointment intervals were not related to failure rate. Few users appear to pay the recommended retail price for materials – discounts were inconsistent.
CONCLUSIONS: Operator experience appears to be more important in determining bonding time than materials and methods.

112 SKELETAL GROWTH CHANGES DURING AND AFTER HERBST TREATMENT IN SUBJECTS WITH DIFFERENT FACIAL TYPES

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AIM: To analyse and compare skeletal growth changes during and after Herbst treatment in subjects with retrognathic and prognathic facial types.
SUBJECTS AND METHOD: Ten retrognathic (mean SNA = 74.1 degrees, SNB = 70.1 degrees, NL/NSL = 12.7 degrees, ML/NSL = 41.5 degrees) and 17 prognathic (mean SNA = 86.9 degrees, SNB = 81.5 degrees, NL/NSL = 5.0 degrees, ML/NSL = 24.7 degrees) Class II division 1 subjects. All the subjects were treated with the Herbst appliance for 7 months, on average. Lateral head films from before, immediately after, 12 months after and 39 months after treatment were analysed. At the different examination times the skeletal morphology of the retrognathic and prognathic group was visualized by polygons.
RESULTS: The amount of mandibular growth change during treatment was comparable in the two groups. However, in comparison with the retrognathic group, the prognathic group exhibited more anteriorly directed changes. This was true for both the treatment and post-treatment periods.
CONCLUSION: In the treatment of Class II division 1 malocclusions with the Herbst appliance, the treatment and the post-treatment effects were more favourable in subjects with a prognathic facial type than with a retrognathic facial type.

113 COMPARISON OF TWO DIGITAL METHODS FOR THREE-DIMENSIONAL MEASUREMENT OF DENTAL CASTS OF CLEFT LIP AND PALATE BABIES

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AIM: To compare two different digital scan methods of dental casts with regard to their clinical practicability, the precision of the surface scans and the method error: 1. Spiral-CT Somatom Sensation (Siemens AG); 2. Light-optical scanner Scan3D (3D-Shape GmbH) based on the illumination with a fringe pattern.
MATERIALS AND METHOD: For evaluation of the precision of the surface scans, one dental cast

was digitized with the two different methods. On five consecutive days, using the Software VoXim (IVS-Solutions AG), three dentists were asked to set seven anatomic landmarks on these digital models. The method error of the digitizing hardware was described by measurement of a metal cube with an exact edge length of 10 mm. To calculate an averaged deviation the cube was digitized 10 times with both methods. The method error of the analysis software was evaluated by measuring one digitized cube 20 times.
RESULTS: The digital representation of the CT-surfaces was more terraced than the light-optical scanned surface. Nevertheless, the average deviation of the landmarks for the light-optical scan was 440 µm, slightly higher than the CT-scan's 370 µm. At 30 µm the method error of the hardware was significantly less with the optical scan. The method error of the analysis software for the light-optical scan was 20 µm and for the CT-scan 10 µm
CONCLUSION: Taking into account the considerably higher post-processing complexity of the CT-scanning procedure and the larger method error, this technology appears less clinically applicable for standard procedures than the light-optical technique. A combination of the light-optical scanner Scan3D with the matching-software Slim3D and the analysis software VoXim, presents itself as the standard of the future for dental cast measurement.

114 DENTOFACIAL CHARACTERISTICS OF PATIENTS WITH DUCHENNE MUSCULAR DYSTROPHY

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AIM: To compare dental and cephalometric characteristics of patients with Duchenne muscular dystrophy (DMD) to a matched control group as well as to normal values found in the literature.
SUBJECTS AND METHOD: Ten patients with DMD with a mean age of 14.3 years (range: 11.6 to 20 years) were compared with 10 healthy controls matched by age. Dental casts and lateral cephalograms were collected of the DMD patients. Only dental casts were obtained of the controls. Inter- and intra-arch relationships were compared with those of the controls and to normal values described by Moyers *et al*. (1976). Cephalometric measurements were compared with norms described by Riolo *et al*. (1974). Due to the heterogeneity of the group with respect to age, the values were transformed into multiples of the standard deviation of normal values.
RESULTS: Three DMD subjects were Class I, two were Class II division 1 and five were Class III. Three had negative overjets. All had open bites bilaterally with distal contacts. Eight had crossbites. The upper and lower dental arches were significantly wider ($P < 0.002$) than those of the controls, the lower arches showing disproportionately greater transverse dimensions than the upper arches. The lower arches were significantly shorter ($P = 0.012$) when compared with the controls. No statistically significant differences in cephalometric characteristics were apparent, except for ANB angle, which was found to be smaller in the DMD group when compared with normal values.
CONCLUSION: DMD affects the dentoalveolar structures through a disruption of the equilibrium between the perioral musculature and the muscles of the tongue due to the effects of the disease on these muscles.

115 TORQUE CAPACITY OF SELF-LIGATING BRACKETS COMPARED WITH STANDARD EDGEWISE BRACKETS

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AIM: To investigate the torque capacity of self-ligating brackets with varying designs compared with metal, ceramic and polycarbonate edgewise brackets.
MATERIALS AND METHOD: Six types of orthodontic brackets were tested in a 0.018 and 0.022-inch slot system: the self-ligating Hanson Speed™ (Strite Ind. Ltd) and Damon 2 (Ormco), as well as the steel-brackets Ultratrimm and Discovery (Dentaurum), the ceramic-bracket Fascination 2

(Dentaurum) and the polycarbonate bracket Brillant® (Forestadent). The brackets were torqued with 0.016 × 0.022, 0.018 × 0.022, 0.018 × 0.025 and 0.019 × 0.025 inch stainless steel archwires. For this purpose, the labial crown torque of an upper central incisor was measured in a simulated intra-oral clinical situation using the Orthodontic Measuring and Simulation System (OMSS). A torque of 20 degrees was applied and the correction of the malalignment was simulated experimentally with the OMSS. Each bracket/wire combination was measured five times. Maximum torquing moments, simulated correction of the labial crown torque, and torque loss were determined.
RESULTS: In the 0.018 inch slot system, the Speed and Ultratrimm brackets generated the highest torquing moments in combination with a 0.018 × 0.022 inch wire (14.4 Nmm), while the Damon and Brillant bracket produced lower moments of 9.4 and 11.5 Nmm, respectively. Torquing moments employing the 0.016 × 0.022 inch wire were approximately 50 per cent lower, and in the 0.022 inch slot system, the moments increased by approximately 30 per cent. Torque loss was highest using the Damon 2 bracket (10.7 degrees with the smaller sized wire) and lowest with the Speed bracket (3.4 degrees with the 0.016 × 0.022 inch wire).
CONCLUSION: Due to a larger bracket/wire play, the Damon 2 seems to have a significantly higher torque loss than the other brackets. Consequently, the torquing moment was lower and the achieved simulated correction was smaller than with the other bracket types.

116 EVALUATION OF PATIENTS' MOTIVATION FOR ORTHODONTIC RE-TREATMENT
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AIM. The present investigation was part of a wider audit of quality of care carried out to evaluate patient satisfaction after orthodontic treatment, and opinions and expectations of re-treatment.
SUBJECTS AND METHOD: A study group was assembled (n = 80) from patients seeking re-treatment after relapse. The study sample consisted of 15 patients (4 males, 11 females) with a mean age of 26.0 years. An initial pilot sample (n = 15) was randomly selected from this group for a structured interview, which was recorded, to obtain broad perceptions of previous care, attitudes to re-treatment, and to score current levels of satisfaction. This information was then utilised to develop a questionnaire for a more detailed investigation of patients attending for re-treatment. A final questionnaire was complied which utilised content information from the pilot study interviews and was assembled with the help of a dental epidemiologist.
RESULTS: The mean age at the start of initial treatment was 11.9 years and the mean treatment time was 2 years. Orthodontists carried out appliance therapy in nine subjects, with the majority of the pilot group (9 subjects) receiving activator therapy, followed by fixed appliances. Only seven subjects of the total sample remembered having any retention after removal of the appliances. The mean analogue score for current satisfaction was 5.7 and the study sample had high expectations of further treatment. Almost all the patients would accept fixed appliance treatment (12 subjects) but few would accept extractions (6 subjects) or surgical correction (5 subjects). The information from these data then formed the basis for a questionnaire that was distributed to the total study sample.
CONCLUSION: A structured recorded interview is necessary to develop a detailed patient centred questionnaire; patient motivation is variable.

117 ERUPTIVE POSITION OF MAXILLARY SECOND MOLARS IN CLASS II MALOCCLUSION SUBJECTS
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AIM: To study the eruptive position of maxillary second molars in subjects with a Class II malocclusion compared with those with a Class I malocclusion.
MATERIALS AND METHOD: The pre-treatment records of 221 patients (mean age 11.3 years) were evaluated. Three groups were distinguished: 19 per cent with a skeletal Class I, 31 per cent with

a skeletal maxillary Class II and 50 per cent with a skeletal mandibular Class II malocclusion. These were determined from the patients' cephalograms based on the SNA, SNB and ANB angles. The eruptive position in relation to a reference line and the developmental stage (Nolla) of the second molars, as well as the patient's dental age were recorded from the panoramic roentgenogram.
RESULTS: The groups were homogenous regarding dental and chronological age and the distribution of the various developmental stages within each malocclusion group. No association was found between skeletal malocclusion type and the dental developmental stage of the second molars. Only in the oldest group, above 12 years of age, were the upper second molars in the maxillary Class II patients more occlusally positioned than in the mandibular Class II or Class I patients. This supports in part previous reports on earlier eruption of maxillary second molars in patients with Class II malocclusions.

118 POSTURAL STABILITY AND UNILATERAL POSTERIOR CROSSBITE: IS THERE A RELATIONSHIP?

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AIM: To test the hypothesis that crossbite affects postural stability.
SUBJECTS AND METHOD: Twenty-six unilateral posterior crossbite subjects (14 males, 12 females) were selected and compared with 52 age-gender matched controls. Postural stability was determined using a stabilometric platform. The following stabilometric measurements were assessed: weight distribution and variations on feet points, speed of body sway, and area of body sway. The tests were performed under two dental conditions: intercuspal position (ICP), and occlusion on two cotton rolls.
RESULTS: The speed of body sway was not significantly (all $P > 0.05$) influenced by occlusal condition (ICP, cotton rolls) ($F = 0.084$), gender ($F = 0.156$), or crossbite ($F = 1.989$). The area of body sway was not influenced by occlusal conditions ($F = 0.394$), occlusal status ($F=0.001$), or gender ($F = 0.354$; $P > 0.05$). The weight distribution was not influenced ($P > 0.05$) by occlusal conditions ($F = 0.928$), crossbite ($F = 0.187$), or gender ($F = 0.086$).
CONCLUSIONS: Unilateral posterior crossbite does not influence postural stability in speed of body sway, area of body sway or weight distribution. Therefore the correction of this malocclusion in order to treat or to prevent postural disorders is not justified.

119 ASSESSMENT OF CEPHALOMETRIC NORMS OF ANATOLIAN TURKISH ADULTS WITH NORMAL OCCLUSIONS AND WELL-BALANCED FACES

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AIM: To evaluate cephalometric standards for the Turkish Anatolian population.
MATERIALS AND METHOD: Data was collected from 50 young males [mean age (± standard deviation; SD), 22.61 ± 1.22 years] and 55 young females [mean age (± SD), 22.14 ± 1.44 years]. All had Turkish parents and their ages ranged between 19 and 25 years. Inclusion criteria was, no or minor tooth crowding, Class I occlusion and normal growth, all teeth present except third molars, good clinical and radiographic facial symmetry, no significant medical history, and no history of trauma, orthodontic, prosthodontic or surgical treatment. Twenty-five measurements (14 linear, 11 angular) were analyzed on each radiograph. For each measurement the mean and SD was calculated. For statistical evaluation, independent *t*-tests were performed. The data obtained were compared with other reported norms.
RESULTS: Significant racial differences, skeletal [anterior nasal spine (ANS) to menton], dental (maxillary incisor to sella-nasion plane, mandibular incisor to nasion-point B line, and mandibular incisor to mandibular plane) and soft tissues (H angle, upper lip to E plane, and upper lip to Steiner S line) were found. Condylion to point A, condylion to gnathion, ANS to menton, and nasion to ANS

measurements were found to be statistically different inter-sexually.
CONCLUSION: These cephalometric findings could be used in orthodontic treatment planning for the Turkish Anatolian population.

120 TOOTH MOVEMENT CHARACTERISTICS WITH DIFFERENT AMOUNTS OF FORCE
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AIM: To investigate the rate of tooth movement of maxillary canines when light and heavy forces are applied with a hybrid retraction spring using mini screws for the anchorage unit.
SUBJECTS AND METHOD: Seven patients (4 females 3 males, with a mean age of 15.17 ± 1.37 years) requiring distal movement of maxillary canines were fitted with hybrid retraction springs. Mini screws were placed bilaterally between the roots of upper first molars and second premolars. Two force levels, 80 and 250 g, were applied for a period of 8 weeks. At 2 weekly intervals, dental casts and intra-oral photographs and at every 4 weekly intervals standard panoramic radiographs were taken. The rate of tooth movement was measured by digital callipers on the study casts. The amount of tipping of the upper canines was measured on standard panoramic radiographs and rotation of the upper canines on the scanned study casts.
RESULTS: The amount of tooth movement for the 250 g force group was 1.01 ± 0.51 mm at week 6 and 1.3 ± 0.52 mm at week 8 and in the 80 g force group, 0.57 ± 0.53 mm and 0.7 ± 0.57 mm, respectively. The amount of tipping was significant only for the 250 g force group at week 8 (distal tipping 2.21 ± 1.9 degrees), while the amount of rotation was significant for both groups (21.07 ± 0.1 degrees in the 250 g group and 15.07 ± 7.2 degrees mesio-buccal rotation in the 80 g group). There were no significant differences between the 80 and 250 g force levels for rate of tooth movement or rotation. On the contrary, greater tipping movement was observed in the 250 g force group.
CONCLUSIONS: The use of low forces in orthodontic tooth movement helps to control the unwanted side-effects of tipping.

121 POLYMORPHISM OF THE VDR GENE AND ITS EFFECT ON BONE TURNOVER IN ORTHODONTIC PATIENTS
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AIM: The human VDR gene, placed in the chromosome 12q14, has two possible codons at the translation starts site (ATG) in the exon 2. A polymorphism T/C in the first start codon, using the restriction enzyme Fok I, was detected. This results in a difference in the length of the VDR, being the mutated allele (F) three aminoacids shorter, which could affect their functions, as the regulation of the gene expression related to bone remodelling, this mutation has also been associated, in some populations, with a higher bone mineral density and a lower predisposition to suffer from osteoporosis. The aim was to study the relationship between the start codon polymorphism of the VDR and the bone turnover produced in orthodontic patients after two years.
MATERIALS AND METHOD: Genomic DNA was isolated from blood samples (n = 44) with a modified phenol-chloroform extraction procedure. The fragment of genomic DNA was amplified by PCR. The products obtained were digested with Fok I restriction endonuclease and then electrophoresed through agarose gel. The subjects were scored as ff homozygotes, Ff heterozygotes and FF homozygotes according to the digestion pattern. Each patient had two panoramic radiographs taken, one at the beginning and the other at the end of treatment, to measure bone turnover after orthodontic treatment, at the lower first permanent molar.
RESULTS: The genotype frequencies were 11.4 per cent ff, 29.5 per cent Ff and 59.1 per cent FF. Two groups differed: 54.5 per cent adolescents and 45.5 per cent adults. According to bone turnover significant differences were obtained in the age ($P < 0.001$) and genotype ($P = 0.002$). The Ff genotype was also different from the FF but as this was only in the adolescents (alpha = 0.05), this

variation depends on the age.
CONCLUSIONS: The data suggest a possible association between the VDR's polymorphism and bone turnover in orthodontic patients.

122 THE EXTENT OF ORTHODONTIC ROOT RESORPTION UNDER AREAS OF COMPRESSION AND TENSION

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AIM: To quantify the extent of root resorption in areas of compression/tension under light and heavy buccal tipping orthodontic forces.
MATERIALS AND METHOD: Data was extracted from a sample of 36 human first premolar teeth with light (25 g) and heavy (225 g) buccal tipping orthodontic forces activated for a period of 28 days. The contralateral sides in the same patient served as controls (0 g). After the teeth were extracted, they were disinfected, imaged under a scanning electron microscope and analyzed using stereo-imaging commercial computer software modified for this study. Buccal and lingual surfaces were divided in to three equal regions: cervical, middle and apical. The root surface area of the three regions was documented with straight-on images. Quantification of resorption craters using volumetric analysis was performed from stereo images taken at ± 3 degrees.
RESULTS: The degree of resorption was correlated to the amount of surface area under compression/tension. The buccal cervical region had 8.16-fold more root resorption in the heavy group as compared with the light force group ($P < 0.01$). All other regions did not seem to have any significant difference within the force levels. For the experimental teeth, there was more root resorption in the high compression regions compared with the other regions ($P < 0.01$). Although there was more resorption per unit area on the lingual apical region compared with the buccal cervical regions, it was not of any statistical significance. Regions under compression had more root resorption than those under tension. There was more resorption in regions under heavy compression when compared with regions under light compression ($P < 0.01$). There was also more root resorption in regions under heavy tension when compared with regions under light tension ($P < 0.01$).

123 WITHIN-RACE AND CROSS-RACE SOFT TISSUE PROFILE PREFERENCES IN A CAUCASIAN POPULATION AND A BANGLADESHI POPULATION

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AIM: To compare, in a prospective, cross-sectional, observational study the soft tissue profile preferences of a Bangladeshi population and a Caucasian population and to evaluate the cross-race and within-race agreement when assessing facial profiles.
SUBJECTS AND METHOD: Fifty six Caucasians and 50 Bangladeshis, aged 18-25 years, judged four sets of facial profile photographs. Assessors were recruited from the outpatient waiting rooms at the Royal London Hospital. Exclusion criteria included previous orthodontic or orthognathic treatment. Each set of photographs represented the same face manipulated into Skeletal I, II and III profiles. The four faces were of a Caucasian male, a Caucasian female, an Asian male and an Asian female. Assessors were asked to choose the most attractive profile for each face.
RESULTS: Chi-squared and Fisher's exact tests demonstrated no statistically significant difference in the profile preference of both groups of assessors when assessing the four different faces with manipulated profiles, of their own race or another race. The two groups chose Skeletal I as the most attractive profile followed by Skeletal II and III, respectively. There were minor variations in the second and third choices, dependent on the face being assessed.
CONCLUSIONS: The aesthetic profile preference for the two groups was Skeletal I. There was cross-race and within-race agreement when assessing facial profiles for attractiveness by both Caucasian and Bangladeshi populations from east London.

124 EARLY BIOFILM FORMATION, BONDING AND ANTIMICROBIAL AGENTS: A PARALLEL PLATE FLOW CHAMBER APPROACH

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AIM: To develop an experimental technique to quantitatively investigate early bacterial biofilm formation on four orthodontic bonding materials. The effectiveness of two commercially available mouthrinses on biofilm formation was also evaluated.

MATERIALS AND METHOD: *Streptococcus sanguis* biofilms were deposited on the disc surfaces of four orthodontic bonding materials (light-cured and chemically-cured composite resins, glass ionomer cement and resin-modified glass ionomer cement) in a parallel plate flow chamber. Artificial saliva was supplied as a source of nutrients. The effects of 0.05 per cent sodium fluoride and 0.2 per cent chlorhexidine gluconate mouthrinses were evaluated. Initial colonisation of the bacterium was assessed after 6 hours of growth by the percentage surface coverage (PSC) on the disc surfaces using the vital staining technique and image analysis software program.

RESULTS: Statistically significant differences in bacterial accumulation were found between different bonding materials ($P < 0.05$), Concise 3M being the least colonised and Transbond XT being the most colonised by *S. sanguis* biofilms. Two-way ANOVA revealed a statistical significant difference ($P < 0.05$) of PSC before and after treatment with the two antimicrobial mouthrinses. Dunnett's T3 multiple comparisons test indicated fluoride had a greater effect in reducing *S. sanguis* biofilms (mean reduction in PSC: 72 per cent) than chlorhexidine.

CONCLUSION: This *in vitro* study shows that the use of chemically-cured composite resin (Concise 3M) reduces early *S. sanguis* biofilm formation. Also, rinsing with 0.05 per cent sodium fluoride prior to placement of fixed appliances has a greater effect in reducing early biofilm formation on bonding materials than chlorhexidine.

125 RAPID PALATAL EXPANSION IN YOUNG PATIENTS WITH PATHOLOGY OF THE NOSE AND EUSTACHIAN TUBE

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AIM: To assess changes in otolaryngological structures before and after rapid palatal expansion (RPE).

SUBJECTS AND METHOD: Twelve patients (6 males, 6 females) aged 6-12 years with maxillary deficiency. The children first underwent an ear, nose and throat (ENT) evaluation (rhinometric measurements and audiometry) followed by orthodontic treatment with a RPE. One month after expansion a second ENT evaluation was carried out to assess the changes as a result of the RPE. The exclusion criterion was the presence of adenotonsillar hypertrophy.

RESULTS: ENT evaluation before RPE showed: Pharyngoscopy: seven patients with the absence of adenoids (adenotonsillectomy). Anterior rhinoscopy: Eight patients with nasal deviation and hypertrophy of the inferior nasal turbinate. Active anterior rhinometric measurement: (pathologic resistance indicated >1.8 at 75 Pascal pressure), six patients with bilateral and six with monolateral nasal obstruction. Posterior rhinoscopy: the sample showed absence of adenotonsillary hypertrophy. Audiometry: mild grade transmission hypacusia (hearing loss 15-25 db) monolateral in one and bilateral in two patients. Tympanometric test (eustachian tube functional analysis): E curve with eustachian tubes deficit (pressure values compliance >-50 mm/water) in five patients and one without hypacusia. ENT evaluation after 1 month of RPE showed: Active anterior rhinometric measurement: bilateral obstruction in five patients out of six normalized; monolateral obstruction in all six patients was within a physiological normal range. Audiometry and tympanometric test: four patients with otologic diseases out of five diagnosed as disease free and only one needed further pharmacotherapy.

CONCLUSIONS: Orthopaedic-orthodontic treatment can be useful in resolving obstructive problems in young patients.

126 EXPERIMENTAL USE OF SKELETAL ANCHORAGE IN ORTHODONTICS: A SYSTEMATIC REVIEW

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AIM: A systematic review of the literature to identify articles relating to the experimental use of orthodontic skeletal anchorage in order to find out biological guidelines.
MATERIALS AND METHOD: The PubMed database was searched for original articles using the subject headings animal study AND orthodontics AND implants. A secondary manual search was realized by screening the reference list of each selected article to identify papers that were not retrieved by the computer search. The following criteria were established for inclusion of an article in this review: (1) animal study with orthodontic or orthopaedic skeletal anchorage, or clinical study with histology of the bone-implant interface of at least two implants, (2) intraosseous bone anchors and (3) articles published after 1983.
RESULTS: Thirty-eight studies were included in the review. The electronic search identified 28 articles, of which only 18 met the selection criteria. Screening of their reference lists resulted in the addition of another 20 papers. Different types of experimental models (animal or human) and implants were used. The healing times ranged from 0 to 48 weeks. In most of the experimental studies good primary stability was obtained before loading, whereas seven studies reported a 3 to 43 per cent failure rate. Osseointegration of titanium implants was observed in all the included studies, but in very different proportions of bone-implant contact. As different methods were used to assess osseointegration, the results were difficult to compare. The integration indices of the mini-implants (range 10-58 per cent) were strikingly lower than the integration indices for conventional implants (up to 93 per cent).
CONCLUSION: No definite guidelines can be extrapolated from these studies because of large discrepancies between the implant types, the methodology used, and the results. The present review highlights the need for further research.

127 REPRODUCIBILITY OF CEPHALOMETRIC MEASUREMENTS OF TWO COMPUTER-AIDED DIGITAL ANALYSIS SYSTEMS

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AIM: To assess the random errors in two different computer-aided digital cephalometric analysis systems and to evaluate the importance of magnification of landmarks on digital lateral cephalograms.
MATERIALS AND METHOD: Landmark identification and digitization was carried out using the Dentofacial Planner software program on analogue lateral cephalograms from 30 consecutive orthodontic patients. The same lateral cephalograms were scanned to digital lateral cephalograms and digitized with the Facad Pc/Windows software program. Digital lateral cephalograms from an additional 30 consecutive orthodontic patients were digitized with and without magnification by Facad. A replicate measurement trial was performed on each procedure with an interval of at least one week, making a total of eight registrations. The variance of error Se^2 according to Dahlberg was calculated for the different variables.
RESULTS: The Se^2 for angular measurements was between 0.11-3.12 for the two systems, with the highest values for the variables NA/upper incisors and NB/lower incisors, respectively. For linear measurements for Se^2 varied between 0.04-0.07 in the two systems. The coefficient of reliability was higher for 13 out of 14 landmarks when ×4 magnification was used in Facad.
CONCLUSION: There were no differences in precision between the two systems. Magnification

of the digital cephalograms by ×4 reduced the error of the measurements.

128 THE MAGNITUDE OF FORCE DELIVERY BY THERMOELASTIC ORTHODONTIC WIRES: THE EFFECT OF TEMPERATURE

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AIM: Low intermittent forces seem to enhance the rate of tooth movement. The aim of this study was to measure the variation in force delivery in a two-bracket system generated by various types of commercially available thermoelastic wires after exposure to water with temperatures ranging from 0 to 65°C.
MATERIALS AND METHOD: Seven commercially available 0.017 × 0.025 inch wires were tested in a Force System Identification apparatus, placed in an incubator operating at mouth temperature. The wires were mounted in a two-bracket system with a 5 mm interbracket distance, which was initially activated by a 4 mm first-order translation and subsequently deactivated to 2 mm. The three-dimensional force system at both brackets was measured during activation and deactivation. After deactivation a dry sponge was placed around the wire/bracket configuration after which volumes of water with temperatures varying from 0 to 65°C in steps of 5°C were injected into the sponge. The force system at both brackets was measured immediately at delivery of the water and every 15 seconds thereafter for 5 minutes.
RESULTS: In general the colder the water the more the force level decreased, and the warmer the water the more it increased. The actual amount of change in force level depends on the type of wire and can go up to twice the force at mouth temperature for hot tea and down to half that force for ice water. Immediately after exposure, the force levels returned to a steady state, which was reached after 1 to 2 minutes. The pre-exposure force level however was never reached entirely, due to hysteresis. This discrepancy was significantly higher for the more flexible wires such as Cu-NiTi40 and NeoSentalloy-100.
CONCLUSION: The largest effect of intermittent force delivery is obtained following alternate rinsing with hot and cold water.

129 FRICTIONAL CHARACTERISTICS OF SELF-LIGATING BRACKET SYSTEMS

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AIM: To assess and compare the *in vitro* tribologic behaviour of four commercially available self-ligating bracket systems.
MATERIALS AND METHOD: The frictional characteristics of the Damon3™, Speed™, In-Ovation R™, and Time2™ bracket systems were studied using a specially designed jig that allowed the three-dimensional movements occurring with dynamic tooth movement during sliding mechanics. Each bracket system was tested on the following archwires: 0.016 × 0.022 inch stainless steel (SS), 0.019 × 0.025 inch SS, 0.020 inch SS and 0.021 × 0.021 inch Speed™ D. An Instron testing machine with a 50 N load-cell was used to measure the frictional resistance for each bracket/wire combination. The crosshead speed rate was set at 1 mm per minute and each typodont tooth was moved along a fixed straightwire segment for a distance of 8 mm. A total of 10 test runs were performed for each bracket/wire combination, with new brackets and wires used for each run. Descriptive statistical analysis for each bracket/wire combination relating to frictional resistance was performed with a two-way balanced ANOVA for bracket type and wire size.
RESULTS: The Damon3™ bracket consistently demonstrated the lowest frictional resistance to sliding, while the Speed™ bracket produced significantly more frictional resistance than the other brackets for all given wires.
CONCLUSIONS: The exact impact of friction on the clinically observed rates of tooth movement, and subsequently on the duration of orthodontic treatment, is unknown. Under the conditions of this

experiment the self-ligating bracket systems tested behaved differently, each reflecting its own technical characteristics.

130 TREATMENT EFFECTS OF A MODIFIED QUADHELIX IN DENTOSKELETAL OPEN BITE SUBJECTS

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AIM: To investigate, cephalometrically, the effectiveness of quadhelix/crib (QH/C) appliance in a group of growing subjects who presented with thumb-sucking habits and dentoskeletal open bites.
MATERIALS AND METHOD: Lateral cephalograms of 23 treated subjects were compared with a control group of 23 untreated subjects with similar vertical relationships. Cephalograms were analyzed prior to the start of treatment (mean age 8.4 ± 1.4 years) and immediately after treatment (mean age 9.9 ± 1.5 years). The mean duration of treatment was 1.5 years ± 7 months. The T2-T1 changes in the two groups were compared by means of a non-parametric test for independent samples (Mann-Whitney *U* test).
RESULTS: The average increase in overbite during therapy was 3.6 mm more than in the controls. Both the upper and lower incisors exhibited a significantly greater lingual inclination (approximately 4.0 degrees for both incisors) associated with a greater extrusion (1.4 mm and 1.0 mm, respectively) in the QH/C group when compared with the control group. The treated group showed a greater downward rotation of the palatal plane when compared with the control group (1.2 degrees). This change was associated with a greater increase in upper anterior face height (N-ANS 0.7 mm) and with a clinically significant reduction in the palatal plane-mandibular plane angle (–1.7 degrees) in the QH/C group with respect to the controls. Both the upper and lower lips showed a significant tendency toward retraction relative to the E-plane in the treated group when compared with the controls (2.6 and 2.9 mm, respectively).
CONCLUSION: The use of a QH/C in growing subjects with a thumb-sucking habit and a dentoskeletal open bite is effective in correcting the dental open bite in 90 per cent of the patients. The QH/C protocol produced a clinically significant improvement in the vertical skeletal relationships due to a reduction in intermaxillary divergence.

131 GENETIC POLYMORPHISMS AND DEVELOPMENT OF GINGIVAL RECESSIONS DURING ORTHODONTIC TREATMENT

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AIM: During orthodontic treatment unforeseeable gingival recessions may occur. The aim of this study was to determine the correlations between polymorphisms of IL-1α and IL-1ß genes, gingival biotype, skeletal malocclusion Class, anterior crowding index and the development of gingival recessions after/during the orthodontic treatment.
SUBJECTS AND METHOD: Forty patients with malocclusions, 20 who showed recession during or after orthodontic treatment (recession group) and 20 subjects (control group), matched for gender, age and orthodontic treatment who did not develop recessions. Peripheral blood sampling and Steiner cephalometry, symphysis width and typology, inferior incisal relationship with mandibular symphysis and occlusal plane and anterior crowding index were evaluated as clinical crown height and probing depth, genetic polymorphisms IL-1α -889 and IL-1ß-511 and +3953.
RESULTS: Comparison of the two groups showed that: .41^OC wider in the recession group and the anterior crowding index was higher in the control group. There was homogeneous distribution of gingival biotype in the two groups, with prevalence of the thin biotype in the recession group. There was a higher prevalence of allele 1 in IL-1α -889 and IL-1ß +3953.
CONCLUSIONS: A relationship does not appear to exist between the onset of gingival recession and

the presence of Kornman polymorphisms, but rather with 41^OC and gingival biotype.

132 LONG-TERM STABILITY OF CLASS II DIVISION 1 MALOCCLUSION CORRECTION WITH A HIGH-PULL HEADGEAR-ACTIVATOR COMBINATION

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AIM: To examine the long-term stability (6.25 years after the completion of the treatment) of Angle Class II division 1 malocclusions treated with a headgear-activator combination, followed by edgewise mechanotherapy.
MATERIALS AND METHOD: Seventy-two lateral cephalometric films from 18 subjects (10 females, 8 males) with an average age of 12.2 years who had an Angle Class II division 1 malocclusion. The lateral cephalograms were taken before (T1), after headgear-activator combination treatment (T2), after orthodontic treatment (T3) and in the long-term out of retention (T4). Cephalometric landmarks were digitized and evaluated using the Macintosh QuickCeph 2000 program. Nine angular and 10 linear measurements were calculated to determine skeletal and dental relationships. Paired samples *t*-tests were used to evaluate the changes in the means of T1 to T2, T1 to T3, T1 to T4, T2 to T3, T2 to T4 and T3 to T4.
RESULTS: Statistical comparison of T1 and T2 revealed that the mandible advanced forward, the upper incisors were retruded and the overjet decreased. Comparison of T3 and T1 showed a decrease in SNA, while T3 and T4 indicated that maxillary and mandibular growth was ongoing, there was no change in the relationship between the maxilla and mandible and overbite increased slightly.
CONCLUSIONS: The headgear-activator combination is an effective method to correct Angle Class II division 1 malocclusions, the relationship between maxilla and mandible remain stable in the long-term. There is no protrusive effect on the lower incisors and the positions of these teeth remain stable in the long-term.

133 BOND STRENGTH COMPARISON OF TWO ORTHODONTIC COMPOSITES WITH OR WITHOUT AN ORTHODONTIC BUTTON

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AIM: To compare the shear bond strength (SBS) of two light-cured orthodontic bonding system with or without AN orthodontic button.
MATERIALS AND METHOD: Sixty human premolars recently extracted for orthodontic purposes were collected and stored in a solution of 0.1 per cent thymol. The criteria for tooth selection included: no caries or fractures and without being subjected to any pre-treatment chemical agents. The teeth were cleaned, polished and randomly separated into two composite groups. Two different types of adhesive system (Transbond XT, 3M Unitek, and Light Bond™, Reliance) were evaluated and used according to the manufacturers' instructions. The vestibular surface of the teeth was used to bond the buttons, and the palatal surface to bond the composite. The composites and buttons were cured with an Optilux 501. For SBS testing, the specimens were mounted in a universal testing machine and a knife-edge was applied at a crosshead speed of 1 mm/minute to each specimen at the interface between tooth and composite until failure occurred. The maximum load (N) was divided by the cross-sectional area of the bonded composite posts to determine SBS in MPa. A paired samples *t*-test was used for statistical analysis.
RESULTS: When both of the composites were applied with buttons, their SBS appeared to be increased two fold ($P < 0.05$). There was, however, no significant difference between materials. In general, a greater percentage of the fractures were adhesive failures at the tooth-composite junction.
CONCLUSION: A number of variables, such as bracket base and fracture strength of the composite may involve bond strength of bracket. Therefore, while testing the bond strength of orthodontic resin composites, using a button or bracket may give some conflicting results.

134 RELEASE OF FGF2, PDGF, TGFß, VEGF AND EGF IN HUMAN DENTAL PULP IN RESPONSE TO ORTHODONTIC FORCE

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AIM: The release of five diffusible angiogenic growth factors in human dental pulp following orthodontic force was investigated using neutralising antibodies (NAs), either in combination or individually, to block their effects. This study investigated the effects of anti-h fibroblast growth factor (FGF2), anti-h platelet derived growth factor (PDGF), anti-transforming growth factor beta (TGFß), anti-h vascular endothelial growth factor (VEGF) and anti-h epidermal growth factor (EGF).
MATERIALS AND METHOD: In a series of investigations, the dental pulps of premolar teeth from patients treated with fixed appliances for 2 weeks were halved vertically, and sections from each half pulp co-cultured with sections of rat aorta in collagen. In the first investigation (n = 10) one each of the five NAs, and in the second investigation (n = 10) of all five NAs together, were added to the media of the co-cultures from one half of the pulp from each tooth, while the other half pulp co-cultures remained without NAs as controls. The cultures were examined daily by light microscopy for angiogenic changes, and growth and the number of microvessels recorded.
RESULTS: The addition of either a combination of five NAs, or five NAs added individually, to the co-cultures of rat aorta and pulp from orthodontically treated teeth, significantly reduced the numbers of pulpal and rat aorta microvessels at day 5 and 10 of culture ($P < 0.05$).
CONCLUSIONS: All five angiogenic growth factors examined were released following orthodontic force application. These factors may be more effective in combination, and play a role in the angiogenic response of the pulp.

135 FREQUENCY OF WHITE SPOT LESION FORMATION WHEN USING RESIN-MODIFIED GLASS IONOMER CEMENT FOR BONDING IN ORTHODONTICS

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AIM: To test the benefit from using a resin-modified glass ionomer cement (RMGIC) in bracket bonding for the prevention of white spot lesion formation.
MATERIALS AND METHOD: The records of 72 patients treated with fixed orthodontic appliances divided into two groups according to the bonding agent used (RMGIC or conventional composite resin). Roth prescription 0.022-inch slot size metal brackets had been used during fixed orthodontic treatment of all the patients. The same oral hygiene protocol had been given to them. The age of the patients at the start of treatment ranged from 12 to 18 years (mean 15 years). The mean treatment time was 19 ± 3 months. Using colour slides taken before and at the end of fixed orthodontic treatment, the frequency of white spot formation on the labial surface of the anterior teeth was determined. A total of 864 teeth, 384 in the RMGIC and 480 in the conventional composite resin group, were evaluated. Comparison between the groups was undertaken using a Chi-square test.
RESULTS: The frequency of white spot formation in the group bonded with RMGIC (7.8 per cent) was lower than the group bonded with conventional composite resin (14.6 per cent). This difference between the groups was statistically significant ($P = 0.002$). The highest frequency of white spot formation was found for the upper lateral incisors in the both groups.
CONCLUSION: The use of RMGIC for bonding of fixed orthodontic appliances reduces the formation of white spot lesions.

136 RELIABILITY OF MEASUREMENTS ON MAXILLARY CASTS OF 'NORMAL' BABIES

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AIM: To evaluate the usefulness of historical longitudinal data from maxillary casts of 'normal' babies. Datasets of this kind are extremely rare and difficult to obtain. Therefore the use of historical data is often necessary.

MATERIALS AND METHOD: Measurements on maxillary casts of 33 (17 boys, 16 girls) normal babies were performed. The casts were measured at birth, and at 3, 6 and 9 months by three observers using two different measurement devices. Two observers used a Reflex microscope (Reflex Measurement Ltd, UK) and one an adapted CM-1 digital readout system (Bondevik *et al*., 1981). The widths and depths of the palatal arch were measured using reproducible mucosal reference points according to Sillman (1951, 1964). The anterior (CC') and posterior (TT') arch width and the anterior and total arch depth (I⊥CC' and I⊥TT') were measured. All children had participated in an interdisciplinary study of early growth and development of normal children and children with cleft lip and/or palate (The Amsterdam longitudinal study). An intraclass correlation coefficient (ICC) was used to compare the two observers using the Reflex microscope and to determine their average to the third observer, and *t*-tests to compare the different techniques.
RESULTS: A high ICC (0.90-0.99) between the two observers using the Reflex microscopes was found. There was a significant difference between the techniques for 11 of the 16 measurements.
CONCLUSION: There was good inter-observer reliability with the Reflex microscopes. If historical control data is to be used, it is recommended that the casts should be measured with the same measurement device, and preferably a Reflex Microscope.

137 EFFECTS OF TEZOSENTAN, A DUAL ENDOTHELIN RECEPTOR ANTAGONIST, ON ORTHODONTIC TOOTH MOVEMENTS IN RATS

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AIM: To determine the effects of tezosentan, a dual endothelin receptor antagonist, on tooth movement in rats.
MATERIALS AND METHOD: Twenty-one male Wistar rats divided into three equal groups. In the first group a superelastic closed coil spring, 25 cN (GAC International), was applied and the rats were treated daily with tezosentan. In the second group a closed coil spring was also used the rats were not treated with tezosentan. The appliance was placed on the upper left first molar and the upper incisors. The third group, where no coil spring or drugs were used, served as the control. The distances between the upper molars and incisors were measured to determine tooth movement using a digitronic calliper (precision 0.01 mm). Measurements were made on days 0, 7, 14, 21 and 25. To determine differences between the groups, one-way ANOVA was performed.
RESULTS: The distances between the upper molars and the incisors decreased in the two groups where a closed coil spring was applied. During the entire study period tooth movement in the group treated with tezosentan was greater compared with the untreated group. On day 25 the difference was significantly greater (1.65 ± 0.46 mm versus 1.04 ± 0.38 mm; $P < 0.05$). In the control group the distance between the upper molars and the incisors increased due to growth.
CONCLUSIONS: The endothelin system plays an important role in orthodontic tooth movement in rats. Further studies with selective ETA and ETB antagonist are needed.

138 ACCURACY OF MANUAL CEPHALOMETRIC TRACING COMPARED WITH ON-SCREEN DIGITIZATION FOR SOFT TISSUE FACIAL PROFILE ANALYSIS

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AIM: To compare the reproducibility and variability of linear and angular soft tissue facial profile measurements, recorded manually on conventionally traced lateral cephalometric images, with on-screen digitization of the same subjects.
MATERIALS AND METHOD: The linear and angular dimensions of 20 subjects were recorded on standardized lateral cephalometric images that defined a soft tissue profile analysis (Sarnäs and Solow, 1980). The subjects were assembled from patients attending for routine orthodontic consultation who had Class I skeletal dental bases. Direct, on-screen point placement and analysis was then carried out for the digital radiographic images using Viewbox 3.1.1.6® software. The same

linear and angular variables were then recorded by manual point placement and direct measurement on printed 1:1 images of the same subjects. Duplicate determinations for both on-screen digitization and manual measurements were carried out for five angular and 12 linear values that defined profile form, and the differences and method errors calculated.
RESULTS: The mean method error s(i) for the on-screen digitization was 0.74 degrees for the angular measurements and 0.41 mm for the linear dimensions. For manual point placement, it was 1.05 degrees and 0.49 mm, respectively. No significant differences were found for intra-sample duplicate determinations between the first and second sets of recordings, for either the manual or on-screen measurements. Significant differences however existed for inter-sample values recorded between the two data sets e.g. nasal protrusion ($P < 0.001$). A plot of the distribution, for on-screen point placement, of the method errors and variance for each variable used in the analysis, showed a smaller range for each.
CONCLUSION: On-screen digitization and analysis shows enhanced accuracy compared with manual point placement and tracing.

139 CHANGES IN ALVEOLAR BONE CONTOUR DURING RETRACTION OF THE UPPER INCISORS

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AIM: To investigate changes in alveolar bone contour of the upper incisors during retraction of these teeth.
SUBJECTS AND METHOD: Nineteen females (average chronological age 18 years 8 months). The upper incisors were retracted with fixed orthodontic appliances. In all cases, 0.022 inch slot brackets were used and the incisors retracted along 0.019 × 0.025 inch stainless steel archwires. Pre- and post-treatment lateral cephalograms were used for the evaluation of the changes of alveolar bone morphology. Lateral cephalograms were superimposed on the ANS-PNS plane at point ANS. Twenty-one linear, angular and area measurements were made. For nine measurements (seven linear and two areas) the tracings of the lateral cephalograms were scanned. Following this scanning, measurements were performed on digital images. Comparison of pre- and post-treatment values was undertaken using Wilcoxon's test.
RESULTS: The upper incisors tipped (14.16 degrees; $P < 0.001$) and the crown apex moved (6.03 mm; $P < 0.001$) palatally. Palatal movement of the root apex (0.40 mm) was not significant ($P > 0.05$). Point A moved posteriorly (0.53 mm; $P < 0.05$). Posterior movement of the anterior and posterior alveolar crests was observed (3.00 mm; $P < 0.001$). No changes in labio-palatal thickness of alveolar bone at the level of the incisor root were found. However, alveolar bone area in front of the incisor root increased (4.13 mm^2; $P < 0.05$).
CONCLUSION: Alveolar bone follows the palatal movement of the upper incisors and the thickness of alveolar bone retained. Thus, the alveolar bone contour remains unchanged.

140 EFFECTS OF MAGNETIC AND MODIFIED SPRING-ACTIVATED APPLIANCES ON THE TREATMENT OF ANTERIOR OPEN BITES

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AIM: To investigate the effects of a magnetic appliance (MAD IV) and a modified spring-activated appliance (MSAA) on the treatment of an anterior open bite (AOB) in growing patients
SUBJECTS AND METHOD: Twenty-six patients who had either a Class I or Class II skeletal malocclusion and a skeletal and dentoalveolar AOB. Each group (MSAA and MAD IV) contained 13 patients. The average chronological ages of the MSAA and the MAD IV groups were 11 years 11 months and 11 years 9 months, respectively. All patients were instructed to wear the appliance for 18 hours/day. Lateral cephalograms were obtained at the beginning and end of treatment. Forty-four

different skeletal and dental parameters were evaluated from the lateral cephalograms. Mann-Whitney *U* and Wilcoxon tests were used for statistical evaluation.
RESULTS: In the MAD IV group the increase of SNA (1.63 degrees), SNB (2.46 degrees), posterior (2.25 mm) and upper (1.58 mm) face height and the decrease of SN/GoGn (4.68 degrees) and overbite (3.08 mm) were significant ($P < 0.01$). In the MSAA group the increase of SNB (1.5 degrees) and upper face height (0.54 mm) and the decrease of SN/GoGn (1.2 degrees), lower face height (1.15 mm) and overbite (3.13 mm) were found to be significant ($P < 0.01$). In both groups, intrusion of the lower molars was observed. However, this was only significant in the MSAA group (1.08 mm; $P < 0.01$).
CONCLUSION: Both appliances alter mandibular growth rotation from forward-downward to forward-upward and produce a positive overbite relationship by reducing the AOB.

141 OVERBITE CORRECTION AND SMILE AESTHETICS

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AIM: Achievement of optimum smile aesthetics during orthodontic treatment has recently been the focus of several orthodontic articles. It has been speculated that overbite correction, specifically maxillary incisor intrusion, will lead to flattening of the smile arc and consequently reduce smile attractiveness. The purpose of this prospective clinical study was to investigate differences in outcomes from two common treatment modalities used to reduce a deep overbite: maxillary incisor intrusion using an intrusion arch and posterior tooth eruption using an anterior bite plate.
MATERIALS AND METHOD: Pre-treatment and post-overbite correction records were gathered from 20 patients who presented with deep overbite malocclusions.
RESULTS: Both the intrusion arch and bite plate modalities effectively reduced overbite ($P < 0.001$) over a relatively short period of treatment. Half of the patients in both groups experienced flattening of the smile arc, in agreement with previous studies showing similar changes in orthodontic patients in general. There was no statistically significant difference between the groups related to changes in the smile arc with treatment ($P > 0.20$).
CONCLUSIONS: Changes in the smile arc are likely due to other factors involved in orthodontic tooth alignment and are not necessarily attributable to the overbite correction method employed during treatment.

142 COMPARATIVE ASSESSMENT OF HARDNESS, ROUGHNESS AND WEAR RESISTANCE OF AESTHETIC BRACKET RAW MATERIALS

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AIM: To assess the hardness, roughness, and wear resistance of materials used for aesthetic bracket manufacturing.
MATERIALS AND METHOD: Samples of poly(oxy)methylene, ultra high molecular weight polyethylene (UHMWPE), two brands of polycarbonate and a polycrystalline alumina raw material used for bracket manufacturing were subjected to Vickers hardness (HV50) testing, profilometry (Ra), and wear resistance testing (scratch test with load of 20 N). The results were analyzed with one-way ANOVA and the Tukey's test (alpha = 0.05).
RESULTS: UHMWPE was shown to be the roughest material followed by alumina; no significant differences were identified among polymeric materials. Alumina had the highest hardness followed by poly(oxy)methylene, whereas the hardness of the two polycarbonate brands varied, implying an effect from the processing method. Wear resistance rankings were consistent with hardness results where the UHMWPE showed the highest wear rate and alumina samples were not affected by the test. The results may have clinical implications for friction, torque expression and appliance integrity and degradation intraorally.
CONCLUSIONS: Polymers used for bracket manufacturing show considerable variability in mechanical and surface properties.

143 EFFECTS OF A LIGHT-EMITTING DIODE CURING ON HUMAN BUCCAL MUCOSA

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AIM: To investigate normal human buccal mucosa by means of immunohistochemistry, regarding the presence and distribution of the neurochemical marker protein gene product 9.5 (PGP 9.5) and to evaluate the expression of this marker after irradiation of the tissue with a light-emitting diode (LED).
MATERIALS AND METHOD: Oral buccal mucosa was obtained from six healthy volunteers under local anaesthesia before and after irradiation with a LED. The indirect immunofluorescence method was employed. Design-based stereology was used to determine statistical differences in morphometric analysis between the non-irradiated (NIR) and irradiated (IR) biopsies.
RESULTS: PGP 9.5 nerve fibres were seen generally in the connective tissue in all the biopsies, but no nerve fibres could be detected in the epithelium. PGP 9.5 positive dendritic cells were found subepithelially and deeper in the lamina propria with different degrees of staining. There were no statistically significant differences regarding the numerical density of fibres and/or cells in any of the layers investigated, between the NIR and IR biopsies. However, the neural pattern showed clear regional differences between NIR and IR tissue.
CONCLUSIONS: The histochemical innervation pattern in the oral buccal mucosa is altered after irradiation with a LED. Further experiments are needed to clarify the influence of light curing devices on human oral mucosa.

144 EFFECTIVENESS OF CEPHALOMETRY IN RELATION TO BIOLOGY

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AIM: Cephalometry is a diagnostic tool aimed at differentiating normal from abnormal facial architecture and also one abnormal pattern from the other. Since the onset of cephalometry, several types of methods have been proposed: fixed external norms, floating norms, patient's facial pattern classification and, more recently, a global analysis using artificial intelligence software. The aim of this study was to test the effectiveness of these four types of methods.
MATERIALS AND METHOD: The classification tested, which has been used since 1976, defines groups where subjects are morphogenetically alike. These groups were matched with groups defined biologically at the cellular level.
CONCLUSIONS: Cephalometry should not be restricted to comparing measured values; these values have to be combined in order to define homogenous patterns of facial growth that includes built-in information about diagnosis and therapy.

145 POST-TREATMENT EVALUATION OF UNILATERAL MAXILLARY FIRST AND SECOND MOLAR DISTALIZATION

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AIM: To evaluate the treatment effects of the distal jet appliance and the effect on the anchorage unit after distalization of maxillary first and second molars.
MATERIALS AND METHOD: Pre-treatment (T1) and post-distalization (T2) dental cast and lateral cephalometric radiographs of nine patients (5 girls, 4 boys) were evaluated. The mean age of the subjects at T1 was 11.5 ± 1.7 years. The mean time for correction of the molar position was 7.9 ± 3.2 months, and the mean total treatment time 26.8 ± 6.2 months. The distal jet was the only appliance used during the distalization phase of treatment.
RESULTS: The maxillary molars distalized (3.2 ± 0.6 mm). Concerning anchorage loss, the second premolars exhibited a significant mesial movement of 0.7 mm. The effect of distalization on the maxillary third molars was extremely variable. No significant changes in either sagittal or vertical

skeletal relationships were observed.
CONCLUSION: The distal jet appliance can be used with other appliances. It is an effective and reliable method for distalizing maxillary molars. Its major advantages are minimal dependence on patient compliance and good patient acceptance.

146 ORTHODONTIC ASPECTS OF TREATMENT OF PATIENTS WITH FAMILIAL ADENOMATOUS POLYPOSIS

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AIM: Germline mutations of the adenomatous polyposis coli (APC) gene cause familial adenomatous polyposis (FAP), an autosomal, dominantly inherited disease that predispose patients to colorectal cancer. Patients with FAP typically develop hundreds to thousands of benign colorectal tumours and early onset colorectal cancer and may have extracolic manifestations, such as osteomas, desmoid tumours, and epidermal cysts. The aim of this questionnaire study was to evaluate the expression and degree of extracolic symptoms, especially changes in the orofacial area in these patients.
SUBJECTS AND METHOD: Eight four patients suffering from polyposis from the multicentre study 'Hereditary Colon Cancer Syndromes' of the Deutsche Krebshilfe, were included. Thirty-nine were revealed as having a mutation in the APC gene.
RESULTS: The total number of questionnaires returned was 21 (54 per cent). Nine patients (43 per cent) reported bone changes in connection with dental changes. Thickening and deformation of the trabecular bone lead to a shift and retention of teeth.
CONCLUSIONS: Since ankylosis of teeth occurs in patients suffering from FAP, fast and specific treatment is necessary. Interdisciplinary counselling and treatment of patients suffering from FAP or of those at risk from families with FAP should be undertaken.

147 CHEMICAL COMPOSITION OF PREFORMED TITANIUM ORTHODONTIC ARCHWIRES – A PRELIMINARY REPORT

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AIM: Burstone and Goldberg (1979) introduced orthodontic wires made from titanium molybdenum alloy (TMA). Since March 1999, their patent has expired and such wires are now freely available on the market from several suppliers. The aim of this study was to investigate the chemical composition of preformed titanium orthodontic archwires.
MATERIALS AND METHOD: Orthodontic rectangular (0.017 × 0.025 inch) preformed archwires were obtained from nine major companies: American Orthodontics™, Dentaurum™, GAC™, Highland Metals™, Ormco™ (this firm supplied both TMA™ and TMA low friction™ archwires), OrthoPlus™, RMO™, TP Orthodontics™, 3M Unitek™. One wire of each brand was randomly chosen for testing. The chemical composition of the alloy making up each sample was established by means of electronic microscopic analysis (with EDS). This proved sufficient for eight of the 10 sample archwires tested. Additionally, a Cameca SX 100 microprobe (with WDS) was used to complete the analysis of the two remaining samples, where the presence of other metals was found.
RESULTS: The metal contents of the eight brands of archwires presently available were closely related, containing approximately 80 per cent titanium and 11 per cent molybdenum. Such alloys are comparable with the original metal combination developed by Burstone and Goldberg (1979), which contained 79 per cent titanium, 11 per cent molybdenum, 6 per cent zirconium and 4 per cent tin. One of the brands on the market had less molybdenum (approximately 4 per cent), while another brand contained more titanium (close to 90 per cent) and no molybdenum. Metals such as aluminium, vanadium and chrome were also found.
CONCLUSION: The metal composition of titanium archwires currently available for orthodontic treatment may vary. Some appear to be quite different from the original ß-titanium alloy. Further

investigations are being undertaken.

148 PAX9 AND MSX1 MUTATIONS: RARE CAUSES OF HYPODONTIA

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AIM: Agenesis of the permanent teeth is one of the most common developmental anomalies, with an incidence ranging from 1.6 to 9.6 per cent. Agenesis presents either in isolation (sporadic or familial) or associated with a syndrome. Autosomal dominant, recessive or x-linked inheritance patterns have been demonstrated. So far eight PAX9-gene mutations have been discovered, all leading to impairment of at least one molecular process regulating tooth formation and causing agenesis, predominantly of molars. The aim of this study was to search for PAX9 mutations in eight oligodontia patients.
SUBJECTS AND METHOD: Based on their severe hypodontia, eight individuals were selected from a high-risk patient group screened earlier for MSX1 mutations. For each patient and his/her first degree relatives, blood samples and panoramic radiographs were taken. Medical history and familial anamnesis for the occurrence of agenesis were reported. PAX9 mutation screening was performed at the University of Helsinki.
RESULTS: All patients reported normal primary teeth and a positive familial anamnesis for agenesis; no clear segregation pattern was however present. The average number of missing teeth in this sample (excluding the third molars) was 12.5, ranging from 7 to 24. No mutations affecting the PAX9 protein were found. One of the patients was heterozygous for a unique nucleotide change in a conserved 5'-flanking region.
CONCLUSIONS: Although the eight patients in this study were considered as high risk, no mutations in PAX9 (nor MSX1) could be demonstrated. PAX9 and MSX1 appear to be rare causes of oligodontia; other genes must play an important role in the signalling pathways of odontogenesis thus explaining the high incidence of severe agenesis and oligodontia.

149 MAXILLARY CANINE DISPLACEMENT AND PREDISPOSITION TO DISTURBED DEVELOPMENT OF THE DENTITION

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AIM: To investigate the relationship between maxillary canine displacement and predisposition to disturbed development of the dentition.
MATERIALS AND METHOD: Panoramic radiographs of 215 patients starting orthodontic treatment were evaluated for the presence of maxillary canine displacement. The level of maxillary canine inclination was established in four different age groups using the method of Dausch-Neumann, by placing a straight line through the cusps of the first molars and measuring the resulting distal angle to the inclined canine. Symptoms of the predisposition to disturbed development of the dentition (displacement of other teeth, hypodontia, hyperdontia and aplasia) were also recorded.
RESULTS: Ninety-one patients showed uni- or bilateral maxillary canine displacement: Sixty-nine exhibited teeth with other developmental anomalies, six with hypoplasia, three with aplasia and two with hyperplasia. Forty-nine of the 124 patients who showed no maxillary canine displacement, exhibited displacements of other teeth, 12 with hypoplasia but none with hyperplasia or aplasia.
CONCLUSION: Careful analysis of each panoramic radiograph can detect maxillary displacement and other predisposition to disturbed development of the dentition at an early stage.

150 ORTHODONTIC TREATMENT NEED OF ADULTS DERIVED FROM A POPULATION-BASED STUDY IN NORTHERN GERMANY

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Germany

AIM: To determine the orthodontic treatment need in adults in a northern region of Germany based on the population-based 'Study of Health in Pomerania'.
SUBJECTS AND METHODS: A total sample of 4310 adults aged 20 to 81 years (response rate 68.8 per cent) 2287 subjects (1076 males, 1211 females) aged 20 to 59 years were selected who had at least 15 or more teeth. Orthodontic treatment need was determined in 10-year-age-strata according to the internationally used and validated Index of Orthodontic Treatment Need, adapted for adults (grades 1 and 2: no treatment required; grade 3: borderline need; grades 4 and 5: treatment required, the most severe malocclusion was responsible for the graduation). Age and gender differences were calculated with the Chi square test. The frequency of completed orthodontic therapy was assessed. The results were compared with similar international population-based studies.
RESULTS: Regarding the total sample, there was a treatment need in 35.5 per cent (n = 811) of the adults. Seven hundred and ninety (34.5 per cent) a showed borderline need, and 30.0 per cent (n = 686) no need. The most frequent malocclusions that lead to 'treatment required' were unilateral crossbite (49.4 per cent) and overjet >6 mm (27.9 per cent). No significant age or gender differences were found. One-quarter (24.0 per cent) of the males and females had undergone orthodontic therapy. While other population-based studies used different indices, they also showed a treatment need for adults of more than one-third (up to 40 per cent). The frequency of completed orthodontic therapy was also similar (approximately 1/4).
CONCLUSION: A high potential for required orthodontic treatment in the adult population exists.

151 QUANTIFICATION OF DENTAL PLAQUE ON SELF-LIGATING AND CONVENTIONAL BRACKET SYSTEMS

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AIM: Fixed orthodontic appliances induce accumulation and retention of bacterial plaque, which constitute a risk for white spot lesions and periodontal disease development during orthodontic treatment. The aim of this study was to investigate and compare the effects of two bracket systems, with different ligation, on microbial dental plaque levels using a conventional plaque index and image analysis system.
SUBJECTS AND METHOD: Thirty patients divided in to two groups: group I treated with Roth brackets and group II with In-ovation brackets. The patient's teeth were disclosed before digital images of the labial surfaces of the upper incisors were acquired. The amount of the plaque present (PA) was quantified using image analysis software and clinical measurements were recorded using the plaque index of Turesky *et al*. The results were compared with *t*- and Wilcoxon's signed rank tests.
RESULTS: At baseline, and at the first and third months no significant difference was found between the groups. At month 6, group I demonstrated higher PA (26.92 ± 7.64) than group II (13.5 ± 9.02; $P < 0.001$).
CONCLUSION: Although no significant differences could be detected during the first months of the study, the group with self-ligating brackets had improved oral hygiene at month 6. The type of bracket ligation seems to affect the amount of plaque accumulating on tooth surfaces together with the efficiency of carrying out oral hygiene.

152 THE EFFECTS OF TWO DIFFERENT BRACKET LIGATING SYSTEMS ON SUPRA- AND SUBGINGIVAL PLAQUE COLONIZATION

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AIM: Fixed orthodontic appliances are associated with increased dental plaque accumulation, elevated white spot and caries risk. The purpose of this study was to evaluate the effects of conventional (Roth) and self-ligating (In-ovation) bracket systems on the amount of *Porphyromonas*

gingivalis and *Streptococcus mutans* colonization in dental plaque.
SUBJECTS AND METHOD: Thirty patients divided in to two groups: group I were treated with Roth brackets and group II with In-ovation brackets. The patients were matched and grouped according to initial plaque indices and the amount of maxillary crowding. Supra- and subgingival plaque samples were collected at baseline and at the third month with sterile paper points. Samples were introduced into reduced transport fluid and cultured within 2 hours for determination of *S. mutans* and *P. gingivalis*. The results were compared with *t*-, Wilcoxon signed rank and Pearson Chi square tests.
RESULTS: At 3 months group I demonstrated higher numbers of *S. mutans* colonization (29800 ± 78 849.08) than group II (2518.75 ± 2860.88) ($P < 0.01$). At baseline and at month 3 no significant difference were found between the groups for the amount of *P. gingivalis* colonization.
CONCLUSION: Within the limits of this study the method of ligation appears to influence the amount of *S. mutans* colonization, which is known to contribute to white spot lesions and caries development during orthodontic treatment.

153 OPTICAL TECHNIQUES IN SHAPE ACCURACY: EVALUATION OF SELECTIVE LASER SINTERING

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AIM: To present a reverse engineering approach, based on the application of fringe projection techniques, to evaluate and validate a selective laser sintering (SLS) mandible replica derived from computed tomographic data processing.
MATERIALS AND METHOD: A three-dimensional (3D) visual and SLS model was made from a dry human mandible. Both the mandible and the model underwent fringe optical measurement techniques to examine the surfaces and point-to-point accuracy of the model. 3D optical scanning devices generates dense point cloud data that have to be treated to obtain usable information. Multiple view matching is necessary to reconstruct the complete model. In the literature the SFF model shape deviation from the dry mandible is evaluated through the positioning of anatomical landmarks and the linear measurements of their distances. The goal of the proposed measurement method is to obtain the complete geometric information of mandible (landmarks are not necessary). In this way, not only corresponding linear dimensions but also free-form shapes can be compared. The last step of measurement process consists of matching the two clouds (real mandible and replica), allowing the calculation of the shape deviation generated during the replica manufacturing process.
RESULTS AND CONCLUSION: The SFF replica deviates from the original mandible in the range +0.08 to –0.17 mm. The maximum error was located around the gonion zone, but the deviation was within a reasonable tolerance value

154 OCCLUSAL TRAUMA AND PERIODONTAL DISEASE

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For many years the issue of whether occlusal trauma is responsible for initiating periodontal disease has been controversial. Occlusal trauma is defined as an injury to the attachment of a tooth or tooth *per* se as a result of excessive occlusal forces. Scrutiny of the literature shows sufficient evidence to support the belief that abnormal forces applied to a tooth in a healthy periodontium do not result in pocket formation or attachment loss. Trauma from occlusion can result in bone resorption and increased tooth mobility; however these changes should be regarded as a physiologic adaptation to a functional demand but not as periodontal disease.
Many orthodontic patients suffer from excessive occlusal forces due to malaligned teeth, tooth loss, or other factors. If there is no correlation between occlusal trauma and periopdontal disease are we being fair to our patients by selling them orthodontic treatment to prevent future periodontal disease?

155 ERUPTION TIMES OF PERMANENT TEETH IN MALE AND FEMALE ADOLESCENTS IN THE CITY OF BREMEN

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AIM: To determine the eruption times of permanent teeth, excluding third molars, in a defined city population.
MATERIALS AND METHOD: Oral findings (2222) were investigated longitudinally in 1621 inhabitants of Bremen (792 males, 829 females). The minimum age was 3.93 years and the maximum 23.94 years. The dental findings were collected over a period of approximately 15 years (1987 to 2002). The oral findings per child were assessed between one and five times.
RESULTS: The eruption times of teeth in females were earlier than those for the same teeth in males. Further, the permanent dentition in females was completed earlier than in males. Tooth eruption occurred symmetrically in both arches. Comparison of both jaws revealed slightly advanced eruption of the mandibular teeth for both genders. There was a definite change in the eruption sequence of the teeth. In contrast to other reports, it was found that eruption of the canines preceded eruption of the second premolars. No acceleration of the dentition was found compared with other reports and confirmed the rules of tooth eruption in mankind.
CONCLUSIONS: Oral examination is a simple tool to calculate tooth eruption intervals. This first investigation on a population of Bremen revealed a change in the eruption sequence of permanent teeth. These findings are relevant for dental treatment planning and should be reconfirmed at certain intervals.

156 ANALYSIS OF ANB, SNA AND SNB ANGLES – A LONGITUDINAL TEST

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AIM: To determine norms and the boundaries of the of SNA, SNB and ANB angles; to extend these boundaries and to test if these norms were the same in different growth periods.
MATERIALS AND METHOD: Seventy-two randomized skeletal Class I (n = 11; 3 male, 8 female) and Class II (n = 13; 5 male, 8 female) lateral cephalograms and handwrist films were evaluated. Recruitment was undertaken by ANB classification at the pre-peak period according to Steiner norms. The cephalometric films were classified as; pre-peak, peak and post-peak growth periods according to handwrist films as related to Helm's criteria. Bonferroni multicomparison and paired *t*-tests were used for statistical evaluation.
RESULTS: The norm for the ANB angle can be used in all growth periods despite differential development and can also be an indicator of disproportion between the jaw sizes. For Class II subjects evaluation of the mandibular position and size according to the SNB angle may be misleading. In the Class II group, the discriminating feature for mandibular size was determined by Go-Me/S-Ba ratio. The diagnostic value of SNB can be improved by this ratio, which is determined in the pre-peak growth period and remains stable. The 82-degree norm of SNA indicates that the greater the angle the larger is the maxilla. Although the size of the maxilla increased to a larger extent than the anterior skull base during growth, the SNA angle did not reflect this condition.
CONCLUSION: Evaluation of treatment effects using SNA angle can be misleading. The average ANS-PNS/S-N ratio in the pre-peak and peak periods will provide more accurate information on maxillary growth.

157 INFLUENCE OF RAPID CANINE DISTALIZATION ON PULP VITALITY, ROOT RESORPTION AND GINGIVAL SULCUS DEPTH

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AIM: To achieve rapid canine distalization using the segmental alveolar distraction method in first premolar extraction cases, to examine the changes in the surrounding periodontal tissues of the distracted canines, to determine the rate of root resorption after distraction, and to evaluate the effect of distraction procedure on the vitality of the distracted canines.
SUBJECTS AND METHOD: Ten teeth in four patients. Periapical radiographs were examined by five different researchers to evaluate the rate of root resorption on three different occasions (before distraction, soon after completion of distraction, and 6 months after completion of the procedure). Electrical vitality testing was performed before and after distraction and during the follow-up period (6 months after the completion of the procedure). In order to evaluate the condition of the periodontal tissues surrounding the canines, gingival sulcus depth was measured at four different points (vestibular, palatal, mesial, distal). In addition, gingival and plaque indices were used.
RESULTS: Electrical vitality testing, performed 6 months after the completion of distraction, showed that three teeth were vital. There was no sign of pulpal pain or discolouration in the rest of the teeth. Radiographic examination revealed no statistically significant difference between the findings regarding root resorption. The results from the periodontal indices showed that there was a statistically significant increase in gingival sulcus depth measured 6 months after the completion of distraction.

158 REPRODUCIBILITY OF SOFT TISSUE LANDMARKS ON THREE-DIMENSIONAL FACIAL SCANS

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AIM: To evaluate the reproducibility of soft tissue landmarks on three-dimensional (3D) facial scans.
MATERIALS AND METHOD: The image scans were taken on a DSP400 facial scanner and were viewed using a customised software program (ShapeFind). Intra-operator data was obtained by the researcher placing 24 landmarks on six scans a total of 40 times. Thirty different orthodontists of varying experience were then asked to place all 24 landmarks on each of the six facial scans. The standard deviations (SD) from the mean were evaluated for each individual landmark in the *x, y* and *z*-axes.
RESULTS: For the intra-operator data, 12 of the 24 landmarks were found to be reproducible to within 1 mm SD for each plane of space. Inter-operator data showed poorer reproducibility with just two landmarks showing less than a 1 mm SD in all three planes of space.
CONCLUSION: Familiarity with the assessment of 3D facial scans is important if reproducibility is to be improved. Experience with software programs and their capabilities may be of more importance than clinical experience.

159 EFFECTS OF RAPID EXPANSION ON 'POSED' SMILES

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AIM: To evaluate the correlation of pre- and post-treatment upper arch width and size of the buccal corridors in individuals treated with rapid palatal expansion (RPE) and to determine the lip-teeth relationship before and after expansion by means of posed smiles.
SUBJECTS AND METHOD: Ten individuals, aged 12 and 16 years, with transverse maxillary deficiency and posterior crossbite treated with RPE and fixed appliances. The hyrax expander was activated 0.5 mm per day. Profile, oblique and frontal smile photographs and plaster casts were measured before and after RPE. The lip-teeth relationship and size of the buccal corridors were analysed according to the smile mesh (Ackermann *et al*., 1998).
RESULTS: The mean expansion was 6 mm. The size of the buccal corridors was reduced after treatment in all subjects. The transverse smile dimension improved and the appearance of the smile became more harmonious at the end of treatment. Flattening of the smile arc during treatment occurred in three patients. Neither gingival recession nor root exposure was observed.

CONCLUSIONS: In patients with a narrow maxillary skeletal width and excessive buccal corridors, a more attractive smile is achieved with RPE

160 DENTOFACIAL CHANGES AFTER INTEGRATED HERBST TREATMENT IN BOYS IN THE PUBERTAL OR POST-PEAK STAGE OF GROWTH

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AIM: To study the effect of treatment with the integrated Herbst appliance (IHA; Haegglund and Segerdal, 1997) on some skeletal and dental variables and compare the treatment results obtained in patients who were in two different stages of maturation – peak and the post-peak stages.
SUBJECTS AND METHOD: From a group of 174 consecutive patients treated with an IHA, 30 boys in the skeletal maturation stage MP3-G and 18 boys in maturation stage R-I-R-J according to Hägg and Taranger (1980, 1982) were selected. The mean age at insertion of the IHA was 14.4 years in the younger group (MP3-G) and 16.5 years in the older group (R-I-R-J). The ANB angle was greater than 3.9 degrees and the overjet > 6 mm. Treatment time was 8.6 months in the younger group and 8.2 months in the older group. Lateral head films were analysed according to the method described by Pancherz (1982).
RESULTS: None of the ANB angle or point A changes differed significantly between the two groups. Mandibular length, on the other hand, increased significantly more (3.3 mm; $P < 0.001$) in the younger compared with the older (1.9 mm) boys. As regards dental variables, overjet was reduced by 7 mm in the younger and by 6.8 mm in the older subjects. The lower incisors were proclined in both groups and incision inferius moved forward in relation to point Pg by 2.5 mm in the younger and 2.0 mm in the older group. None of these variable changes differed significantly between the groups.
CONCLUSION: Mandibular length increased significantly more in the MP3-G maturation group than in the group in the R-I-R-J stage of maturation. With this exception, the treatment effects obtained with the IHA in the two groups did not show any significant difference.

161 DOES THE MODE OF MANDIBULAR ADVANCEMENT AFFECT THE TREATMENT EFFECTS ON MOLAR RELATIONSHIP?

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AIM: This prospective clinical study compared the molar relationship effect between mandibular stepwise advancement and maximum jumping.
SUBJECTS AND METHOD: The headgear activator group (HGA-S) had stepwise advancement (n = 24, mean age = 11.9 ± 1.2 years) of 4 mm every 3 months with individualised bite opening following the condylar translatory pathway, whilst the HGA-M group (n = 31, mean age = 11.2 ± 1.5 years) had maximum jumping with edge-to-edge 6 mm interincisal opening. Active treatment was 12 months (T0-T12) for the HGA-S group and 6 months (T0-T6) for the HGA-M group followed by 6 months (T6-T12) of retention. Molar relationship effects were analysed from lateral cephalograms (Pancherz, 1982) taken at start of treatment (T0), 6 months (T6) and 12 months of treatment (T12). The results were adjusted to similar observation lengths. Growth changes were obtained from the pre-treatment HGA-M group.
RESULTS: The molar relationship was unchanged with 6 months' growth. With the initial 6 months' treatment (T0-T6) the molar relationship improved 2.8 mm ($P < 0.001$) and 3.2 mm ($P < 0.001$) with HGA-M. With HGA-S, jaw base relationship improved 2.1 mm ($P < 0.001$) whereas the molars were unaffected. With HGA-M, jaw-base relationship improved (1.5 mm; $P < 0.01$), maxillary molars distalized (–1.1 mm; $P < 0.01$) and mandibular molars mesialized (0.6 mm; $P < 0.01$). During the second 6 months (T6-T12) of active treatment, the molar relationship improved with HGA-S (1.9 mm; $P < 0.001$) mainly due to an improved jaw base relationship (1.4 mm; $P < 0.05$). After HGA-M retention, the molar relationship was unaffected, due to an insignificant jaw base relationship effect

and relapse of the maxillary molars. During the total 12-month observation period, the effect on the molar relationship was significantly larger ($P < 0.05$) with HGA-S than HGA-M.
CONCLUSION: With mandibular stepwise advancement there seem to be more skeletal and less dental effects contributing to the improved molar relationship.

162 CEPHALOMETRIC NORMS OF CHINESE: MODIFIED BJÖRK'S ANALYSIS
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AIMS: To establish cephalometric norms for Chinese using modified Björk's analysis (1947) and compare them with those of Caucasians.
MATERIALS AND METHOD: Lateral cephalometric radiographs taken in natural head posture of a random sample of 200 male and 205 female 12-year-old southern Chinese together with 43 male and 43 female 12-year-old British Caucasians in Hong Kong. The radiographs were digitised twice with the CASSOS program.
RESULTS: In males, the inter-incisal angle, A,B on OP and SN length were significantly larger in Caucasians than in Chinese. On the other hand, the SNA, SNB, SN/MnPl, SN/MxPl, SN/Ui, Ui/MxPl, Li-APo, upper face height and upper and lower lip to E line were significantly larger in Chinese males than in Caucasian males. For females, NSBA, ANB, inter-incisal angle, A,B on OP and SN length were significantly larger in Caucasian than in Chinese. On the contrary, SNA, SNB, SNPg, SN/MnPl, SN/MxPl, SN/Ui, Ui/MxPl, Li-APo, upper and lower face height, and upper and lower lip to E line were significantly larger in Chinese females than in Caucasian females.
CONCLUSIONS: There are significant differences between Caucasians and Chinese when using the modified Björk's analysis.

163 ORTHODONTIC SPACE OPENING IN PATIENTS WITH CONGENITALLY MISSING LATERAL INCISORS
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AIM: Insertion of implants in subjects with missing lateral incisors requires specific orthodontic tooth movement.
MATERIALS AND METHOD: Twenty-eight plaster casts and cephalograms of 14 patients with orthodontic space opening for 26 missing lateral incisors were used for calculation of the angle between the incisor and occlusal plane. The cross-section of the alveolar bone was sliced at the level of implant insertion. The first cast (T1) was taken between 10.08 and 14.91 years of age (start of treatment) the second (T2) between 12.83 and 17.25 years of age (finish) and the third (T3), in selected cases, at the time of insertion of an implant (in the same cases T2=T3). For calculation of the angle and cross-section in the buccal-palatal direction, a microscope, Leica MZ 12, with the software, Leica Qwin, was used.
RESULTS: If the necessary bone surface for an implant is 72 mm² (6 × 12 mm) the lack of alveolar bone surface varied from 0.17 to 10.40 mm² at T2. The distance between implant and bone buccal surface was, in subjects where early treatment had been undertaken, on average less. The vertical decrease was significant. The thickness of the bone layer was between 1 and 3 mm if the treatment started later than 14 years of age. The angle between the incisor and occlusal plane decreased in all subjects.
CONCLUSION: In both groups incisor protrusion occurred which is a disadvantage for axial loading of implants. When orthodontic treatment for space opening is required treatment should not start before 13 to 14 years of age.

164 CEPHALOMETRIC CHANGES FOLLOWING MAXILLARY PROTRACTION USING ONPLANTS AS ANCHORAGE – A PILOT STUDY
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AIM: To determine cephalometric changes following maxillary protraction using onplants as anchorage device.
SUBJECTS AND METHOD: Five patients with skeletal Class III malocclusions treated with a protraction facemask using onplant as anchorage. Lateral cephalometric radiographs were used to quantify the skeletal and dental changes before and immediately after treatment. Cephalometric changes were compared with a group of control subjects with no treatment. Data were analyzed using the *f* test.
RESULTS: With 12 months of treatment, the overjet was corrected from –3.2 to –0.9 mm. The maxilla moved forwards 2.1 ± 1.3 mm compared with –0.2 ± 2.5 mm in the control group. The molar relationship was improved to a Class I dental arch relationship. The maxillary incisors moved labially 1.5 mm in the onplant group and lingually 0.9 mm in the control group. The maxillary molars moved forward 0.6 mm in the onplant group and backward 0.1 mm in the control group. Vertically, the overbite was decreased by 2.4 ± 2.5 mm compared with 0.7 ± 1.8 mm in the control group. The maxillary molars extruded 1.3 ± 0.4 mm in the onplant group.
CONCLUSION: Onplants can be used as stable anchorage to prevent forward movement and excessive extrusion of the maxillary molars during maxillary orthopaedic treatment.

165 DOES A CIRCUMFERENTIAL FIBREOTOMY ENHANCE STABILITY AFTER ORTHODONTIC TREATMENT? – A RANDOMIZED CLINICAL TRIAL

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AIM: To examine the effect of a circumferential fibreotomy at the end of orthodontic treatment on the rotational stability and crowding of lower incisors. The null hypothesis was that fibreotomy does not influence post-orthodontic stability or crowding.
MATERIAL AND METHOD: From all patients finishing multibracket appliance treatment between 11/2003-9/2004 all those fulfilling the selection criteria (3-5 mm crowding before treatment, Class II molar relationship, non-extraction treatment, no aplasia) were prospectively and consecutively included in the study. The total number of patients was 10, however, one refused to participate. At the end of multibracket appliance treatment, the lower archwire was removed and a circumferential intrasulcular fiberotomy was performed from lower canine to lower central incisors on a randomly chosen side (left or right). No retention devices were incorporated. Recall examinations were performed after one, two, four and six months. Dental casts and intraoral photographs from before and after treatment as well as from all recalls were photographed using a standardized method. The photographs were traced and analysed using Little's irregularity index, as well as superimposition of the photographs.
RESULTS: Rotational relapse and crowding was seen to varying degrees in all patients. There was no significant difference in rotational stability or crowding between the sides with or without fibrotomy, using either Little's irregularity index or superimposition.
CONCLUSION: Performing a circumferential fibrerotomy does not enhance post-orthodontic rotational stability or lower incisor crowding.

166 ULTRASONOGRAPHIC VISUALIZATION AND EXTENT OF FOETAL CLEFT LIP AND PALATE

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AIM: Prenatal diagnosis of cleft lip and/or palate (CLP) is important to enable parents to be informed about the condition, and for planning treatment. The purpose of this study was to investigate the possibility of ultrasonographic visualization to define the extent of foetal facial CLP.

SUBJECTS AND METHOD: Five foetuses with facial cleft were examined. A two-dimensional (Acuson 128 XP 10) ultrasound was used by a well-trained sonographer to describe and measure the clefts. The gestational age when prenatal diagnosis was made was between 20 and 25 weeks. A combination of coronal, sagittal, and axial scans of the face was obtained.
RESULTS: A cleft lip (CL) was identified as a loss of the continuity of the orbicularis oris muscle from a coronal or axial view of the lips. Cleft alveolar ridge was suspected by discontinuity of the c-shaped maxillary tooth-bearing alveolar ridge as well as an irregular contour with absent or abnormally implanted anterior tooth sockets. Under excellent examination conditions (a low body mass index of the mother, good foetal and head position, gestational age between 20-22 weeks) the integrity or a cleft of the hard palate could be detected in an axial view.
CONCLUSION: Detection of a CL and alveolar ridge is a standard in prenatal ultrasonographic diagnosis, but the detection of a cleft palate is difficult and requires excellent conditions and a well-trained sonographer.

167 BODY DSYMORPHIC DISORDER IN ADULT ORTHODONTIC PATIENTS

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AIMS. Body image plays an important role in patients seeking orthodontic treatment. It affects how a patient feels about their physical appearance and, in extreme cases, may lead to a patient having a subjective fear of ugliness. This could be diagnosed as body dysmorphic disorder (BDD) where a physical defect is present which, although within normal limits, seems far more noticeable to the patient. Such patients need to be recognised before commencing treatment.
SUBJECTS AND METHOD: This interview-based study was designed to assess BDD in adult members of the general public and in adults attending the Orthodontic Department at the Eastman Dental Hospital for an initial consultation for orthodontic treatment. A total of 70 members of the general public and 40 patients were assessed. The Yale-Brown Obsessive Compulsive Scale interview was used for diagnosis of BDD.
RESULTS: BDD was diagnosed in two members of the general public and in three patients.
CONCLUSION: It is important to have an understanding of body image and be able to identify those patients attending for orthodontic treatment who may have BDD. These patients are rarely satisfied with the results of their treatment and it is therefore important to recognise them so as to avoid unnecessary treatment and refer them for appropriate management.

168 SKELETAL EFFECTS OF CLASS II DIVISION 1 MALOCCLUSIONS

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AIM: To compare the skeletal effects of the growth guide appliance (GGA) to development in a untreated control group.
SUBJECTS AND METHOD: Twenty-eight patients (19 girls and 9 boys) treated between 1992 and 2003 with a GGA, a modified headgear with a vertical twin pad located in the lower lip sulcus. The age at the start of treatment/first cephalogram was 10.41 ± 0.96 years. The control group was a random sample of untreated Zurich children from a growth study, 21 girls and 26 boys, with a first cephalogram taken at 10.04 ± 0.77 years of age. The mean observation period between cephalograms 1 and 2 was 1.84 years for treated patients and 3.68 for the controls. Three reference points, orbitale, porion and sella turcica were used to define an *x*-*y* co-ordinate system within which 32 landmarks were recorded and 34 parameters measured. Superimposition for analysis of mandibular growth was performed on menton-gonion (*x*-axis), and a perpendicular through pogonion (*y*-axis). For statistical analysis, the data were normalized to 1-year differences. Differences between the two groups were tested, using the Mann-Whitney *U* test.
RESULTS: The annualized increase of the SNB-angle was significantly greater in the GGA-group

(0.68 degrees/year) than in the control group (0.38/year; $P < 0.01$). Local superimposition of the mandible on the pre- and post-treatment cephalograms showed significantly more mandibular growth per year, measured as the distance condylion-pogonion, in the GGA-group (3.33 mm/year) than in the control group (2.36 mm/year; $P < 0.001$).
CONCLUSION: The GGA enhances mandibular advancement in growing patients with a Class II division 1 malocclusion.

169 STRESSES AND STRAINS ON THE CRANIAL BASE INDUCED BY RAPID MAXILLARY EXPANSION

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AIM: To investigate the effects of rapid maxillary expansion (RME) on the cranial base using the finite element method. Of special interest were stresses, strains and deformations around the foramina of the cranial base with their vulnerable neural and vascular structures.
MATERIALS AND METHOD: A virtual simulation model of the sphenoid consisting of 19,383 single finite elements was generated. Using this model, consisting of tetrahedron elements, 10 simulations were carried out in all, i.e. five with the juvenile and five with the adult sphenoid. Within these individual simulations both pterygoid plates were bent laterally by 1, 2, 3, 4 and 5 mm, as occurs in a patient during RME if the junction between the maxilla and pterygoid plates is not separated.
RESULTS: RME lead to moderate stresses and deformations in the juvenile sphenoid but serious complications are unlikely in this region of the cranial base. Because of the decreasing elasticity of the skeletal structures the situation was different in the adult model. Due to lateral bending of the pterygoid plates a marked a stress occurred in the region of round foramen, oval foramen and the superior orbital fissure, where fractures with neural and vascular injury cannot be excluded.
CONCLUSION: Surgical separation of the maxilla from the sphenoid is an important procedure for preventing complications in the cranial base region in adults.

170 MANDIBULAR DEFORMATION AMONG VIOLIN PLAYERS

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AIM: Pressure is exerted against the violinist's mandible while playing the instrument. The aim of this study was to compare the craniofacial morphology of violinists with that of patients with mandibular deformities using standardized frontal cephalograms.
SUBJECTS AND METHOD: Ten violinists and 15 patients with mandibular deformities. Data was collected for the following lines: zygoma, mastoid, anterior nasal spine to menton, condylion, antegonion notch and the maxillary molar. Correlation analysis was carried out on all of these lines.
RESULTS: Among violin players, there was a correlation between the antegonion notch line and the zygoma line ($P < 0.01$). There was a correlation between the antegonion notch line and anterior nasal spine to menton line ($P < 0.05$). The same was true for the antegonion notch line and condylion line. Among mandibular deformity patients, a correlation was observed between the antegonion notch line and anterior nasal spine to menton line ($P < 0.01$). Correlation for the condylion line and the zygoma line was significant at the same level. There was a correlation between the antegonion notch line and maxillary molar line ($P < 0.05$).
CONCLUSION: The temporal bone of violinists is deformed in a similar manner to that of patients who use a chin cap. However, the temporal bone in mandibular deformity patients is not deformed.

171 ANALYSIS OF TONGUE MOVEMENT DURING SPEAKING SEQUENCES IN DIAGNOSIS OF TONGUE THRUST

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AIM: It is important to examine tongue movements more closely by applying objective methods in

order to clarify the aetiological significance of orofacial malfunctions for malocclusions and speech disorders. The aim of this study was to analyse the movement of the tongue during speaking sequences using electromagnetic articulography to find objective parameters for the diagnosis of tongue thrust.
SUBJECTS AND METHOD: Thirty adults without any orthodontic or functional deviation in tongue movements were measured with an electromagnetic articulograph developed at the University of Tübingen. The subjects were monitored during 10 repetitions of a German sentence with the target utterance 'ta'-consonant-'at' in the middle. Six different types of target utterances were used (tasat, taschat, tatat, talat, tanat, takat). One receiving coils was glued to the tip of the tongue and two others 2 and 4 cm further dorsally. Tongue movement during these utterances was analysed with regard to geometric (distances, angles) and time variables.
RESULTS: All types of utterances showed that both consonants 't', built typically at different positions, were suitable as a marker for the analysis. The maximum of the amplitude of the vowel 'a' corresponded with the most inferior position of the tongue. During the second vowel the tongue had a more posterior and cranial position. The records of the first coil at the tip of the tongue showed the maximal distances of the different sections of tongue movement for most of the utterances. In contrast to this, analysis of 'takat' showed the best results in using the third coil 4 cm posterior to the tip of the tongue.
CONCLUSION: Analysis of geometric and time intervals of articulatory movements using electromagnetic articulography offers the opportunity for objective diagnosis of tongue thrust.

172 DENTOFACIAL CHANGES FOLLOWING MANDIBULAR ADVANCEMENT APPLIANCE TREATMENT IN OBSTRUCTIVE SLEEP APNOEA PATIENTS

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AIM: To evaluate long-term dentofacial changes in obstructive sleep apnoea (OSA) patients treated with an oral mandibular advancement appliance.
MATERIALS AND METHOD: The lateral cephalograms obtained in natural head posture from a sample of 67 consecutive OSA patients (50 males, 17 females; mean age: 46.9 ± 8.9 years) treated with an oral mandibular advancement appliance at start of treatment (T0), and after one (T1), two (T2) and three (T3) years of treatment. The lateral cephalograms were digitized twice with at least two-week interval and the average of the two readings was used for statistical analyses. The method errors for linear and angular measurements ranged from 0.3-0.7 mm and 0.4-0.7 degrees, respectively.
RESULTS: Small but statistical significant changes were found for some dentofacial variables. Lower anterior face height steadily increased over the whole observation period, the increase being statistically significant for T0-T1 and T1-T2 periods, and marginally statistically significant for T2-T3 period. A significant increase in the mandibular plane angle was observed during T0-T1 and T2-T3 periods, whereas in the T1-T2 period there was no significant change. As for the dental changes, a significant reduction in overjet and overbite were observed for T0-T1.
CONCLUSION: Treatment with an oral mandibular advancement appliance in OSA patients showed that lower anterior face height continued to increase over a three-year observation period. Overjet and overbite changed only during the initial period. There were also some other changes. Even though the dentofacial changes were statistically significant, the magnitudes were considered to be small.

173 DENTOFACIAL CHARACTERISTICS RELATED TO SEVERITY OF OBSTRUCTIVE SLEEP APNOEA

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AIM: To evaluate the dentofacial characteristic related to the severity obstructive sleep apnoea (OSA).
SUBJECTS AND METHOD: One hundred and seventeen consecutive male OSA patients (mean age:

46.6 ± 10.2 years) referred for oral mandibular advancement appliance therapy. Baseline lateral cephalometric radiographs were obtained in natural head posture and digitized twice with at least a two-week interval. The average values from the two measurements were used for statistical analyses. The apnoea-hypopnoea index (AHI) was obtained from the patient's baseline polysomnography report and the sample was subdivided into two groups according to the disease severity indicated by the AHI, mild to moderate severity group (AHI < 30) and severe group (AHI ≥ 30). The mild to moderate OSA group had 64 subjects (mean age: 46.1 ± 11.5 years) and the severe OSA group 53 subjects (mean age: 47.2 ± 8.5 years).
RESULTS: The sample demographic data showed that body mass index was significantly greater in the severe group. The soft palate length (PNS-U) was significantly longer in the severe group and tongue base was significantly more inferiorly placed as measured by PNS-V distance. Significant increases were also observed for the severe group in the cranio-cervical extension measured by the OPT/SN and c2sp.c4ip/SN angles. Although the position of the hyoid bone was more inferiorly and anteriorly placed in the severe group, it did not reach a significant level.
CONCLUSION: Obesity and soft tissue abnormalities may aggravate the severity of OSA. Head posture in the severe OSA group showed greater cranio-cervical extension.

174 SHEAR-BOND STRENGTH OF ORTHODONTIC BRACKETS USING AN ANTIMICROBIAL SELF-ETCHING PRIMER

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AIM: Caries development in the form of white spot lesions is a side-effect of orthodontic therapy with fixed appliances. The study was conducted in order to evaluate the shear bond strength (SBS) of a new antimicrobial fluoride releasing self-etching primer (Clearfil Protect Bond, Kuraray, Japan) in comparison with a conventional bonding preparation.
MATERIALS AND METHOD: Ninety extracted human incisors and premolars were randomly divided into three groups of 15 teeth each. The bonding procedure in group 1 was carried out according to conventional preparation (phosphoric acid, rinse and dry, Transbond XT Primer, 3M Unitek). For group 2 the antimicrobial self-etching primer (ASEP) was used, while in group 3 phosphoric acid (PA) and ASEP (manufacturers' recommendation for uncut enamel in direct restorations) was employed. Upper lateral incisor and premolar brackets (Mini-Diamond, Ormco, USA) were bonded with a light-cured adhesive (Transbond XT, 3M Unitek). After 48 hours of storage SBS was measured with a testing machine (Zwick Z2.5, Zwick, Germany). Intergroup differences were investigated by an analysis of variance.
RESULTS: The mean values and standard deviations of the SBS forces were: incisors: PA 139.48 ± 42.88 N; ASEP 120.18 ± 39.98 N; PA ± ASEP 165.57 ±- 46.48 N; premolars: PA 134.07 ± 37.24 N; ASEP 142.07 ± 28.97 N; PA + SAEP 149.42 ± 55.06 N. There were no statistical differences between the SBS of groups 2 and 3. The new antimicrobial fluoride releasing self-etching primer did not affect the SBS.
CONCLUSION: Considering the clinically acceptable bond strength and the advantage of the antibacterial feature, this method is recommended in order to minimize the side-effects of fixed orthodontic appliances. Studies are required to investigate the clinical performance.

175 CONE-BEAM TOMOGRAPHIC IMAGING OF MANDIBULAR CONDYLE DEFORMATIONS ASSOCIATED WITH JUVENILE IDIOPATHIC ARTHRITIS

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AIM: To assess morphologic condylar deformations associated with juvenile idiopathic arthritis (JIA) using cone-beam tomography with custom-made software.
MATERIALS AND METHOD: Panoramic radiographs of 39 JIA patients were examined by two orthodontists to assess possible deformations of the mandibular condyles. Fifteen patients (9 females,

6 males, mean age 12.2 years; range 5.9–19.5 years) were referred for further radiological investigation. Local computer tomographs were made by means of the cone-beam device (3D Accuitomo®, Morita, Kyoto, Japan) at 80 kV, 68 mAs per slice, and 360 degrees rotation, to collect data on both temporomandibular joints with a resolution of 2.5 Lp/mm. Critical positioning of the head was carried out after scouting the two regions of interest in cylindrical volumes (diameter 40 mm, height 30 mm). Two-dimensional (2D) images were analyzed on line in the sagittal, transverse and horizontal planes and custom-made software was applied to visualise the condyles three-dimensionally.
RESULTS: On the 2D images mandibular deformations could be exactly localized and determined in the sagittal, transverse and horizontal plane; cortical involvement could also be discriminated. The severity of the deformations was related to the mandibular cephalometric parameters on the lateral headplate. Three-dimensional images were obtained to visually inspect the local surface morphology of the mandibular condyles.
CONCLUSIONS: With the appropriate software, cone-beam tomography is an efficient diagnostic technique to assess condylar morphologic deformations at a low radiation dose.

176 DENTAL DEVELOPMENT IN CHILDREN WITH UNILATERAL CLEFT LIP AND PALATE

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AIM: To assess dental age in children with a complete unilateral cleft lip and palate (UCLP) and to compare that with children without a cleft.
MATERIALS AND METHOD: Records of 70 consecutive children (45 boys, 25 girls) with UCLP (with or without Simonart's band) born between 1976 and 1988. All patients were treated in the Cleft Palate Craniofacial Centre of the Radboud University Nijmegen Medical Centre. Patients with syndromes or other congenital malformations of the face were excluded. Non-Caucasian patients as well as those with missing teeth, other than the third molars, were excluded. Dental age was assessed on 373 dental pantomograms according to the method of Demirjian *et al*. (1973) and Demirjian (1978). Linear interpolation in individual age curves was applied to obtain the dental age at 5, 9.5 and 14 years. For these age groups a comparison was made with a sample of non-cleft children (90 boys, 91 girls) of the same population from the Nijmegen Growth Study.
RESULTS: A statistically significant delay in dental age was found for boys with UCLP at 5, 9.5 and 14 years of age compared with non-cleft boys. In girls with UCLP a statistically significant delay in dental age was only found at 5 years. At 9.5 and 14 years of age, no differences were found.
CONCLUSION: There is a delay in dental development in UCLP children and especially in boys. Further studies are necessary to provide more knowledge of the origin of the differences in dental age between UCLP boys and girls.

177 EVALUATION OF INTRAORAL MAXILLARY MOLAR DISTALIZATION WITH COMPACT RAPID PALATAL EXPANSION SCREWS

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AIM: To achieve molar distalization without distal tipping and anchorage loss and minimize treatment time and patient co-operation.
SUBJECTS AND METHOD: Five males and five females with a mean age of 14 years 7 months. The criteria for patient selection were a bilateral Class II molar relationship, permanent dentition completed, erupted maxillary second molars, maxillary third molars present and with acceptable morphology, and normal or low angle skeletal pattern. For appliance construction, maxillary first molars and premolars were banded and impressions taken. On model, a modified Nance, attached to both premolars, was constructed and extended anteriorly to act as a bite plane. The distalising unit

consisted of 'compact rapid palatal expansion' screws (Ormco, part no: 600-0200, product no: 9000-700, maximum opening: 11 mm), connecting the maxillary first molars and first premolars palatally on each side. Nance and distalising unit connection was formed from 0.9 mm diameter wire, underlying the Nance button. After cementation, the maxillary second molars were extracted. To minimize distalization time and tipping, vertical and horizontal cuts were performed on the wall of interdental septum facing the first molar, additional to interradicular septum removal. Twenty-four hours after extraction, screw activation began (once every two days), each turn meaning 0.25 mm activation. Distalization was achieved in a mean time of 2 months 11 days, and the result was stabilised by a conventional Nance appliance. Initial, after distalisation, and 2-month follow-up cephalometric radiographs were taken for each patient.
RESULTS: First molar distalisation was, on average, 3.2 mm with 7.35 degrees of distal tipping. The first premolars were mesialized 3.8 mm with 9.35 degrees of mesial tipping and the upper incisors mesialized 4.7 mm with 10.1 degrees of uprighting. Anchorage loss was reduced to 0.05 mm for premolars and 2.4 mm for the incisors.
CONCLUSION: The main advantages of this appliance are rapid distalisation with convenient patient activation and easy fabrication.

178 INVESTIGATION OF SPHENOID SINUS DEVELOPMENT**
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AIM: To examine sphenoid sinus development and changes in dental occlusal developmental stages.
MATERIALS AND METHOD: Micro-measurement of the sphenoid sinus area was carried out using an image analysis device, short axis and long axis at 2 and 4 mm vertical width maximum area of sphenoid sinus as a measurement standard. Ten individual dried human skulls were selected for each stage according to the Hellman's age classification and 100 samples were evaluated. Computed tomographic images were inputted through a computer CCDTV camera. Frame recordings were prepared via processing through binary coding after shading compensation.
RESULTS: 1) The upper fault area 4 mm from the maximum area was not apparent from IA to IC. 2) The upper fault area 2 mm from the maximum area was not evident at IA. 3) The sphenoid sinus maximum area was not apparent at IA. 4) The lower fault area 2 mm from the maximum area was not observed in the IA period. 5) The lower fault area 4 mm from the maximum area was not evident from IA to IC.
CONCLUSIONS: Each fault area in the sphenoid sinus demonstrated a gradual increase during certain periods of dental occlusal development. However, the fluctuation difference increased with development; individual differences exert a strong influence in developmental areas.

179 RELATIONSHIP BETWEEN MAXILLOFACIAL MORPHOLOGY AND MASSETER MUSCLE VOLUME AND INCLINATION
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AIM: To compare the relationship between maxillofacial morphology, masseter muscle inclination and volume, and the physical features of mandibular prognathic patients with those of normal subject.
SUBJECTS AND METHOD: Twelve mandibular prognathic patients (mean age 21.5 years) and 25 males (mean age: 27.6 years) with normal occlusion. Maxillofacial morphology was observed on lateral cephalograms. The volume and inclination of the masseter muscle were determined from magnetic resonance images.
RESULTS: The volume of the masseter muscle in mandibular prognathic patients was not correlated with any items; the inclination of masseter muscle was related to SNB, ANB, FMA, FH-palatal plane, gonial angle, ramus inclination, and *y*-axis. For the normal occlusion subjects, the inclination of the masseter muscle was not correlated with any item, but the volume of masseter

muscle was correlated with FMA, MP-palatal plane, gonial angle, SN-GoGn, posterior face height and saddle angle.
CONCLUSIONS: The inclination of the masseter muscle is correlated with mesiodistal development.

180 COLLAGEN MATRICES IN PALATAL WOUND HEALING
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AIM: Cleft palate surgery leaves open wounds on the palate due to a shortage of tissue. The healing of these wounds impairs dento-maxillary growth by wound contraction and scar formation. The implantation of a suitable substrate might diminish this problem by reducing the adverse effects of the healing process. The aim of this study was to investigate the effect of a collagen matrix with and without heparin on palatal wound healing.
MATERIALS AND METHOD: Matrices (Ø 3 mm) composed of cross-linked bovine collagen with and without covalently bound heparin were implanted submucosally in the palate of 30 rats. The rats were sacrificed 1, 2, and 4 weeks after implantation. The inflammatory response, the formation of new blood vessels, the ingrowth of cells, and the degradation of the matrices on haematoxylin and eosin stained sections were evaluated.
RESULTS: One week after implantation ingrowth of the cells had commenced and a mild to severe inflammatory response was observed around the matrices, which ceased after 4 weeks. Ingrowth of new blood vessels commenced after 2 weeks. After 4 weeks the matrices were completely infiltrated with host cells and were partly resorbed. In comparison with the collagen matrices, the collagen-heparin matrices showed more cell ingrowth, more vascularisation and less degradation.
CONCLUSIONS: Collagen matrices with heparin are suitable for implantation in the palate of rats and induce a more favourable tissue reaction than matrices of collagen alone. Collagen-heparin matrices can also be used to deliver growth factors into the wounds.

181 COMPARISON OF THREE SETS OF INDIVIDUALIZED (FLOATING) NORMS FOR ANB
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AIM: To compare three sets of individualized (floating) norms for ANB, derived from different material, and to evaluate their suitability to be used in cephalometric diagnosis of sagittal malocclusions.
MATERIALS AND METHOD: Lateral cephalograms and dental plaster casts of 75 untreated orthodontic patients, 36 male and 39 female, representing Angle's Class I (n = 33), II (n = 27), and III (n = 15) malocclusion cases. The mean age of the patients was 9.6 years (SD = 1.8 years). Individualized norms were computed from the Class I malocclusion group, estimating the relationship of ANB to SNA and NSL/ML by means of regression analysis. Two other sets of norms were obtained from earlier studies. Three sets of individualized norms were compared with each other by classifying the material into skeletal malocclusion Classes using these norms and by comparing the results of these classifications with Angle's classification.
RESULTS: Approximately half of the variation in ANB was caused by variations in its reference system. The best agreement between the cephalometric and Angle's classification could be achieved when individualized norms obtained from the present material were used and the diagnostic criteria for Class I were set in the limits of 0 ± 1.5 degrees. The present norms characterized the present material; the earlier norms were typical of the material used in the earlier studies. Changing Steiner's criteria (confidence interval = 0-4 degrees) did not significantly improve the accuracy of ANB.
CONCLUSIONS: A marked part of the difference in ANB originates from the variations in its reference system, for which reason skeletal classification based purely on ANB can be misleading in individual patients. In longitudinal studies of growth or treatment changes, the use of individualized norms for ANB, adjusted to the material to be studied, could allow more accurate results than the use

of ANB.

182 ORTHODONTIC TREATMENT OUTCOME IN LINKÖPING MEASURED BY THE INDEX OF COMPLEXITY, OUTCOME AND NEED

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AIM: Today there is a demand for quality assessment of orthodontic treatment outcome from the Swedish National Health Board. The aim of this study was to assess orthodontic treatment outcome in the Center of Orthodontics and Pedodontics in Linköping, Sweden. The Index of Complexity, Outcome and Need (ICON) was used as an indicator for quality.
MATERIALS AND METHOD: The study models and patient records of 109 adolescents (55 females, 54 males) treated using the 0.022-inch straightwire technique. The patients were consecutively selected from the debonding list (May 2003 to October 2003). Prior to registration there was a calibration exercise including 10 cases similar to numbers 1-10 in the aesthetic assessment section of the ICON. Four orthodontists and one postgraduate student participated. The postgraduate reassessed the ICON score on the same 10 models one month later. The standard error calculated by Dahlberg's formula, was 5.5. All pre- and post-treatment study models were registered according to the method used by Daniels and Richmond (2000), and the ICON scores were calculated. Identification was masked on all study models, and they were evaluated randomly so that it was unknown to the examiner if the models were taken prior to or after orthodontic treatment. In addition, of data such as treatment duration, type of appliance, and extracted teeth, were collected.
RESULTS: The preliminary results displayed a mean ICON score before treatment of 57 (minimum 26; maximum 110). The mean ICON score post-treatment was 18 (minimum 4; maximum 41).
CONCLUSION: The occlusion of patients was substantially improved after orthodontic treatment with the 0.022-inch straightwire technique as measured using the ICON.

Daniels C, Richmond S 2000 The development of the index of complexity, outcome and need (ICON). Journal of Orthodontics 27: 149-162

183 SECULAR TRENDS IN MALE SKULLS FROM THE 19TH CENTURY TO THE PRESENT ANALYZED WITH GEOMETRIC MORPHOMETRICS

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AIM: To investigate how Austrian facial form has changed over the last one hundred years, e.g. changes in growth patterns, changes in shape patterns, or some combination thereof.
MATERIALS AND METHOD: Cephalograms from a combined sample of 54 recruits in the present Austrian Federal Army together with 49 dried skulls of soldiers in the Imperial Hapsburg army. Age distributions of the two samples were comparable. Body height was measured or acquired from military records, and 43 landmarks were located on each lateral cephalogram roughly in keeping with the system of Riolo *et al*. (1974). Secular change and growth allometry were analyzed by standard Procrustes methods.
RESULTS: Body height correlated only weakly with the size of the facial skull in these samples, and secular change in facial size was less than that in height. Growth allometry was nearly unchanged over the century, emphasizing the typical changes of vertical to horizontal proportions and bimaxillary prognathism. Secular changes over the century took the form of far more localized remodelling around the coronoid process and the anterior maxilla.
CONCLUSION: The observed trends shed considerable light on secular changes in the range of dysmorphologies found needing clinical orthodontic correction. At the same time, the discrepancy between within-century and between-century allometry is an important outcome that was hitherto typically observed only after larger time scales than the century spanned by the present data.

184 THE PERIODONTAL LIGAMENT BEHAVES AS A FIBRE-REINFORCED POROVISCOELASTIC MATERIAL

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AIM: To describe the mechanical response of the periodontal ligament (PDL) during the first five hours of orthodontic force application.
MATERIALS AND METHOD: Seven young adult male beagle dogs (age 1.0–1.5 years). After extractions and placement of implants, custom-made orthodontic appliances were placed on both sides of the mandible to distalize the second premolars. Initial tooth movement was measured during the first 5 hours of force application. Each dog had two measurement sessions. One premolar was moved with a force of 100 cN in the first session and with 50 cN in the second, while the contralateral premolar was moved with 100 and 300 cN, respectively.
RESULTS: The time displacement curves showed a rapid instantaneous response followed by a slowly decreasing creep displacement. The large initial differences between dogs faded with the time of force application.
CONCLUSIONS: The initial response showed large individual variability, probably influenced by individual differences in tooth and PDL anatomy and by the orientation of the periodontal fibres. The viscoelastic material properties of the PDL fibres become increasingly important after the first seconds of tooth movement. The PDL is a complex material that can be considered as a fibre-reinforced poroviscoelastic material.

185 LONG-TERM FOLLOW-UP OF INCISORS WITH ORTHODONTICALLY INDUCED APICAL ROOT RESORPTION

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AIM: To evaluate tooth mobility in maxillary incisors in relation to root length and alveolar bone height, and to study the long-term change in alveolar bone height.
MATERIALS AND METHOD: One hundred and thirty nine orthodontically resorbed maxillary incisors in 38 patients treated 10 to 25 years ago. Intraoral radiographs taken after active treatment were available for all patients. Recording of patients´ general health and periodontal status, registration of the teeth in occlusion, and function and radiographic examination was performed at the follow-up control. The radiographs were analyzed and total root length and alveolar bone height was measured. Tooth mobility was assessed clinically using Miller's index and the Periotest method.
RESULTS: The relationship between Periotest value and root length and alveolar bone height, respectively, was statistically significant ($P < 0.05$). There was increased mobility in incisors with a total root length < = 9 mm and alveolar bone height < = 7 mm. The proximal alveolar bone loss during the follow-up period was in agreement with the average change (0.09 mm/year) reported in epidemiological studies. The decrease in alveolar bone height was not significantly related to root length.
CONCLUSION: There is a risk of tooth mobility in incisors with severe apical root resorption. The change of alveolar bone support, over a 10 to 25 year period post-treatment, seems to be similar in orthodontically treated incisors with severely resorbed roots as in those with a mild resorption.

186 BONE-TO-IMPLANT CONTACT OF ORTHODONTIC IMPLANTS IN HUMANS – A HISTOMORPHOMETRIC INVESTIGATION

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AIM: To evaluate the percentage of direct bone-to-implant contact of 20 orthodontic anchorage

implants (Orthosystem, Institute Straumann, Waldenburg, Switzerland) after completion of active orthodontic treatment.
MATERIALS AND METHOD: Twenty orthodontic implants (diameter 3.3 mm, length: 4 or 6 mm) were inserted into different topographic-anatomic regions of 18 adult patients for orthodontic anchorage purposes. Sixteen implants (1 per patient) were placed in the midpalatal area, two (bilaterally, 1 patient) into the retromolar area of the mandible and also two implants (bilaterally, 1 patient) in the zygomatic area. The unloaded healing period lasted 3 months, whereas the loading period ranged from 9 to 22 months. Thereafter the implants were removed with a specific bone drill and prepared for histological and histomorphometric evaluation.
RESULTS: The mean percentage of direct bone contact at the endosseous implant body was 67.63 per cent for the palatal implants (n = 16), 64.85 per cent on average for the retromolar implants (n = 2) and a mean of 60.45 per cent for the zygomatic implants (n = 2).
CONCLUSIONS: The findings demonstrated a relatively high bone-to-implant contact at the surfaces of the loaded implants. This seems to be favourable for the maintenance of osseointegration during orthodontic loading of length-reduced implants.

187 A SOFT MANDIBULAR ADVANCEMENT DEVICE: CRANIOFACIAL AND DENTOALVEOLAR CHANGES

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AIM: Snoring and obstructive sleep apnoea (OSA) are related to narrowing of the airways. The mandibular advancement device (MA) increases the hypopharyngeal dimensions and may reduce the number of apnoeas as well as snoring. The MA device is similar to an activator. Sagittally the mandible is advanced approximately 50-70 per cent of the total protrusion capacity. Vertically there is a distance of 6 mm between the incisors. The aim of this investigation was to study possible craniofacial and dentoalveolar effects resulting from the use of a soft MA device.
SUBJECTS AND METHOD: Fifty-four adult individuals who had been using the soft MA device regularly for 2-6 years. Lateral radiographs and study casts were obtained prior to treatment and at the follow-up examination. The radiographs were digitized and the study casts measured using a digital calliper. The differences between the registrations were compared statistically.
RESULTS: There were small but significant reductions in overjet and overbite as well as increases in incisor and mandibular inclination.
CONCLUSION: Since OSA is progressive and may result in life threatening disorders the small craniofacial and dentoalveolar changes registered may be regarded as a minor in relation to improved health and quality of sleep. However the patients should be informed of the side-effects of the MA device.

188 *IN VIVO* COMPARISON OF THE FORCE DEGRADATION PROPERTIES OF FOUR BRANDS OF ELASTOMERIC POWER CHAIN

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AIM: To compare the force degradation properties of four brands of elastomeric power chains after six-weeks of intra-oral use.
SUBJECTS AND METHOD: Sixteen subjects aged from 16 to 31 years of age who were receiving fixed orthodontic treatment and who had to undergo the extraction of one premolar in each of the four dental arch segments, which was an essential part of the treatment to retract the maxillary and mandibular canines. Comparative effectiveness of canine retraction for the four brands was not considered. Five-links of four different brands of power chains were fixed from the canine hook to the molar tube hook of the first molar in all four quadrants. The four brands were randomly assigned to each quadrant for each patient. Force measurements were recorded with a Correx gauge and the distance between the canine and the first molar with a Mitutoyo Vernier calliper. The readings were

carried out at three time intervals: at band placement, and three and six weeks after placement.
RESULTS: All brands of power chain showed considerable force loss from the first to the second reading (3 week period) but no difference from the second to the third reading (6 weeks from the start) for each brand. Thus, an initial mean force of 250 g was reduced to a mean residual force of 155 g in the first 3 weeks and to less than 105 g after 6 weeks in three brands. One brand showed significantly more force degradation, with less than 40 g remaining after 6 weeks.
CONCLUSION: Although all brands of power chain lost significant force over the 6 week period, the residual active force could be sufficient for continuing orthodontic effect for three of the four brands of power chain.

189 VALIDITY AND RELIABILITY OF A THREE-DIMENSIONAL SOFTWARE PACKAGE IN THE MEASUREMENT OF FACIAL IMAGES

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AIM: To assess the feasibility and success of a three-dimensional (3D) software package, (RapidForm 2004) in the measurement of facial morphology. This retrospective study was carried out on a random sample of 35 laser-scanned images from the facial growth study conducted at the University of Wales College of Medicine.
MATERIALS AND METHOD: Two Minolta VIVID 900 3D optical digitizers were placed as a stereo pair to capture the soft tissue of the subjects. The acquired data was input into RapidForm 2004 as point cloud measurements and converted to triangulated 3D meshes. Prior to merging a stereo image, extensive pre-merging data preparation was carried to remove noise and redundant data and to smooth out distortions in the scanned image. Two methods (automated and regional alignment) were used to align and merge the left and right scanned data.
RESULTS: There was little difference in aligned images if there was no movement in the clinical subject. However, in dealing with 'live' patients, there was an inevitable difference between left and right scans despite the patient's best efforts to remain still. The built-in fully automated alignment procedure showed a left-to-right image deviation of 0.5 to 1.0 mm (SD = 0.2 mm) compared with 0.4 to 0.8 mm (SD = 0.2 mm) resulting from regional alignment; still object tests showed a deviation of 0.3 to 0.4 mm.
CONCLUSION: The RapidForm 2004 software package is deemed to be a reliable tool for the manipulation of 3D data obtained from optical laser scanning devices. Furthermore, the regional alignment method with pre-merging data preparation gives an improved merged 3D representation of the live subject.

190 EXPERIMENTAL, NUMERICAL AND IMMUNOHISTOCHEMICAL STUDY OF EARLY TOOTH MOVEMENT IN RATS

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AIM: In this study, experimental, numerical and immunohistochemical investigations were performed to analyze whether the initial biological reaction to short-term orthodontic loading was initiated via the ERK-Cbfa1 pathway.
MATERIALS AND METHOD: In a novel animal-experiment, the upper right first molars of 25 anaesthetized rats were loaded with forces of 0.1 N. The forces were kept constant for 15 minutes and 1, 2, 4 or 8 hours and recorded with a high-resolution force/torque transducer. The untreated contralateral sides served randomly as control or were used to generate finite element models (FEM). Paraffin-embedded sections were analyzed using immunohistochemistry for proliferating cell nuclear antigen (PCNA), core binding factor alpha-1 (Cbfa1/Runx2) and phosphorylated extracellular signal-regulated kinase 1/2 (pERK1/2). Counting of immunohistochemically positive cells was performed in two separate areas located mesio-coronally and disto-coronally to the mesial root. Student's *t*-tests were used to determine differences between groups and with regard to the localization of counted

positive cell nuclei. Based on micro-computed tomographic scans FEM were developed. The stress/strain distributions associated with orthodontic loading were determined in the periodontal ligament (PDL) and compared with the results of the immunohistochemical study.
RESULTS: Positive normal tensile stresses and strains were calculated in the PDL in areas located disto-coronally. In this classical 'tension zone', the number of Cbfa1-positve and pERK1/2-positive cells increased up to 8 hours of loading. However, in areas located mesio-coronally, these numbers were significantly lower than those of the control. This coincided with negative normal tensile stresses and strains, the classical 'compression zone'. No significant changes of PCNA-positive cells were determined in either area.
CONCLUSIONS: Osteoblast differentiation via the ERK pathway seems to be the early response of PDL cells to mechanical stimulus. Additionally these results indicate that strains and stresses in the PDL seem to be the mechanical key stimulus of orthodontic bone remodelling.

191 THE PATTERNS AND CHARACTERISTICS OF CONGENITALLY MISSING TEETH

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AIM: To study the prevalence, frequently occurring sites of congenital missing teeth and their correlation with other teeth through epidemiological investigation.
SUBJECTS AND METHOD: Six hundred and eleven males and 1011 females who had attended the orthodontic department of Yongdong Severance Hospital for three years from September 1, 1999 to August 31, 2002. The characteristics of congenitally missing teeth were studied using examination records, radiographs and diagnostic models, and the statistical significance was analyzed using Chi-square test.
RESULTS: 1. The prevalence of congenitally missing teeth was 11.2 per cent, with no significant difference between males and females. 2. 70.9 per cent of the subjects had unilateral congenital missing teeth and 28.1 per cent bilateral missing teeth. 3. The prevalence rates were 49.5 per cent in the mandible, 29.1 per cent in the maxilla, and 21.4 per cent in both arches. 4. The prevalence of the mandibular second premolars and mandibular lateral incisors was 20.4 per cent, the maxillary second premolars (14.3 per cent), maxillary first premolars (11.3 per cent), maxillary lateral incisors (10.6 per cent), mandibular central incisors (6.4 per cent), and maxillary canines (6.1 per cent). 5. The rates for missing third molars were 48.2 per cent in the congenitally missing group and 27.4 per cent in the normal group. 6. Only the maxillary lateral incisors showed smaller mesiodistal diameters in the congenitally missing group in both genders. For other teeth, there was no significant difference in size.
CONCLUSIONS: Congenitally missing teeth usually occur unilaterally and in the mandible. The most prevalent missing teeth were the mandibular second premolars and lateral incisors.

192 QUALITY CONTROL IN ORTHODONTICS

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AIM: To determine the quality of care provided by all operators working in three hospital-based orthodontic departments at York, Harrogate and Scarborough, England.
MATERIALS AND METHOD: Fifty consecutively treated cases were scored using the Peer Assessment Rating (PAR) index for 11 operators working in three hospital-based orthodontic departments (n = 550). All completed cases were included. PAR scoring was carried out by a calibrated operator. The efficiency of treatment was assessed using an extension of PAR scoring, the 'efficiency factor' (change of PAR score per month of active treatment).
RESULTS: For the 550 cases PAR scored there was a mean pre-treatment PAR of 34, mean post-treatment PAR = 9, mean percentage PAR reduction = 71.8 per cent and mean treatment time = 24.5 months. The efficiency factor = 1.02 (i.e. a reduction of PAR score of 1.02 points per month).
CONCLUSIONS: The quality of care provided within the hospital-based orthodontic departments at

York, Harrogate and Scarborough is of an acceptable standard. PAR scoring provides a very useful means of comparing operators within and between treatment centres. The efficiency factor is recommended as a useful extension of PAR scoring.

193 CLASS II DIVISION 1 MAXILLARY FIRST MOLAR EXTRACTION TREATMENT – MECHANISM OF OVERJET CORRECTION AND SPACE CLOSURE

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AIM: To analyse the following changes occurring during Class II division 1 treatment with the Begg-method in combination with extraction of maxillary permanent first molars: (1) skeletal and dental components involved in overjet correction and (2) mesial and distal tooth movements contributing to extraction space closure.
MATERIALS AND METHOD: Lateral head films of 62 subjects from before and after treatment were scrutinized using the sagittal-occlusion analysis of Pancherz (1982).
RESULTS: (1) The overjet was, on average, reduced by 5.4 mm ($P < 0.001$). This was accomplished by advancement of the mandibular base by 1.6 mm (31 per cent), counteracted by retrusion of the maxillary base by –0.5 mm (–10 per cent), retrusion of the maxillary incisors by 3.0 mm (56 per cent) and protrusion of the mandibular incisors by 1.3 mm (23 per cent). (2) Maxillary extraction space closure by an average of 10.9 mm ($P < 0.001$) was accomplished by mesial second molar movement of 9.0 mm (83 per cent) and distal second premolar movement of 1.9 mm (17 per cent).
CONCLUSION: In the present Class II division 1 sample treated by maxillary first molar extractions and Begg-mechanics, overjet correction was accomplished by 79 per cent dental and 21 per cent skeletal changes. Extraction space closure resulted from 83 per cent mesial second molar movements and 17 per cent distal second premolar movements.

Pancherz H 1982 The mechanism of Class II correction in Herbst appliance treatment. A cephalometric investigation. American Journal of Orthodontics 82: 104-113

194 ARCH WIDTH CHANGES IN EXTRACTION AND NON-EXTRACTION TREATMENT IN ANGLE CLASS I PATIENTS

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AIM: To retrospectively examine the dental arch width changes following extraction and non-extraction treatment in Angle Class I patients.
MATERIALS AND METHOD: Pre- and post-treatment dental casts of 60 patients (30 extraction, 30 non-extraction). Their mean ages were 14.3 ± 2.02 years and 14.1 ± 2.9 years, respectively. Maxillary and mandibular crowding was –6.7 ± 3.1 mm and –6.3 ± 2.8 mm for the extraction group and –4.5 ± 3.6 mm and –2.1 ± 3.5 mm for the non-extraction group, respectively. Measurements of intercanine and intermolar widths of the maxillary and mandibular arch were carried out using a digital calliper. A paired samples *t*-test was used to evaluate the treatment changes within each group. To compare the changes observed in both groups, an independent samples *t*-test was used.
RESULTS: At the start of treatment the maxillary and the mandibular intercanine and intermolar widths of both groups were not statistically different. At the end of treatment the maxillary and mandibular intercanine widths of both groups were significantly increased. The decrease in mandibular intermolar width for the extraction group and the increase in maxillary intermolar width for the non-extraction group were statistically significant. The decrease in maxillary intermolar width for the extraction group and the increase in mandibular intermolar width for the non-extraction group were not significantly different. No differences were observed between groups in maxillary and mandibular intercanine widths. Maxillary and mandibular intermolar width indicated a significantly larger value in the non-extraction group than in the extraction group.

195 THE EFFECTS OF FIRST PREMOLAR EXTRACTIONS ON THIRD MOLAR ANGULATION

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AIM: To determine the relationship between the inclination of the second molars and the inclination of the third molars over a 2-2.5 year period in patients treated orthodontically with and without premolar extractions.
MATERIALS AND METHOD: Records of 37 first premolar extraction patients and 33 non-extraction patients were examined. A control group of 30 subjects was selected to compare the findings of the extraction and non-extraction groups. The pre- and post-treatment panoramic radiographs were analyzed. The angles were measured between the long axis of the third molar and the occlusal plane, and between the long axis of the third molar and the long axis of the second molar. Changes in third molar angulations from pre- to post treatment for the two groups were compared by Mann-Whitney *U* test.
RESULTS: Statistical analysis revealed that mandibular third molars showed an improvement in angulation relative to the occlusal plane in the first premolar extraction group.

196 FUNCTIONAL INFLUENCE OF OCCLUSAL FACTORS ON THE SPINE

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AIM: To demonstrate the influence of occlusal changes to the stability and the mobility of the spine.
MATERIALS AND METHOD: Using an ultrasonic mobility analyser (SonoSnes, Jena) the stability and mobility of the spine was recorded. The patients investigated (n = 11) suffered from myogene craniomandibular dysfunction. The controls (n = 4) showed no signs and symptoms. All patients and controls were first registered in the natural intercuspal position. After incorporating a relaxation splint in the upper jaw, stability and mobility of the spine were recorded. The functional measurements were repeated at 6, 12 and 52 weeks.
RESULTS: Spinal function changed shortly after incorporation of a relaxation splint. The changes could be proved statistically for the regularity index, sagittal motion, the sagittal motion index, frontal motion and the frontal motion index.
CONCLUSION: Stability and mobility of the spine are interdependent of the occlusion. In future this 'hard' data can be taken into account while planning orthopaedic and orthodontic treatment.

197 PREDICTORS FOR POST-TREATMENT OVERBITE STABILITY

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AIMS: Prediction of post-treatment overbite stability by dental and skeletal vertical dimensions.
MATERIAL AND METHOD: In this retrospective study, lateral cephalograms of 220 children taken before orthodontic treatment (mean age 11.0 ± 1.2 years), after active orthodontic treatment (mean age: 14.8 ± 0.6 years) and at least 3 years post-retention (mean age 26 ± 4.4 years) were evaluated. The interrelationships between post-treatment overbite changes and facial skeletal and dental development during treatment were studied using regression analyses.
RESULTS: When post-treatment overbite development was predicted by pre- and post-treatment variables and changes during treatment, bite opening was associated with pre-treatment proclined upper incisors, little increase in the upper alveolar depth and lower incisor retroclination during treatment, a large vertical increase of the upper alveolar height during treatment and a large post-treatment lower alveolar height (multiple r = 0.46). When changes during the post-treatment period were added, bite opening was associated with a large increase in symphyseal area and minimal increase in upper alveolar depth during treatment, proclined upper incisors at the end of active

treatment and upper and lower incisor proclination during the post-treatment period (multiple r = 0.62).
CONCLUSIONS: Incisor inclination is an important factor in the stability of overbite correction. Lower incisor retroclination during treatment may not be stable and appears to lead to post-treatment bite opening. This may indicate that extraction therapy in open bite patients should be performed with minimum anchorage. Overbite development appears to be independent from development of lower face height during and after treatment. Excessive development of the symphyseal area during treatment may enhance some degree of relapse of the open bite.

198 ORAL AND OTOLARYNGOLOGIC IMPROVEMENTS AFTER RAPID MAXILLARY EXPANSION

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AIM: To evaluate aural effects after rapid maxillary expansion (RME) treatment in subjects with maxillary constriction and oral habits, such as oral breathing and swallowing.
SUBJECTS AND METHOD: Sixteen subjects (6 females, 10 males) age range 5-11 years, with maxillary contraction and recurrent acute otitis media were studied using panoramic radiographs, latero-lateral and postero-anterior cephalograms and study models. Information on the number of acute otitis media attacks and oral habits were obtained by parental questionnaire. Cephalometric measurements were: sagittal analysis (SNA, SNB, ANB, SN-GoMe), vertical analysis (FMA, SN-GoGn, ANS-PNS-MP, S-Go/N-Me per cent, SGo-NMe), dental analysis (IMPA, FMIA, UI-FP, overjet, overbite), aesthetic analysis (E-UL, E-LL, ANL), and growth prediction analysis (NSAr, SAr-ArGo, ArGo-GoMe, ArGo-GoN, Ngo-GoMe). Several measurements were calculated on the models. Otolaryngologic diagnostic examinations were carried on before and after RME treatment using a two-banded modified butterfly expander cemented to the maxillary teeth.
RESULTS: After RME all subjects showed vertical suture opening and improved transversal diameters. Audiologic examination showed a diminution of nasal air resistance in six subjects, and an increase in hearing capacity in 12 subjects. Clinical examination showed the resolution of oral breathing and a good improvement in swallowing in most of the subjects.
CONCLUSION: Early treatment of malocclusions using RME can resolve oral breathing, increase the width of the nasal air passage, and reduce risk of recurrent ear pathologies.

199 EXPRESSION OF CBFA1 AND COLLAGEN X IN THE MANDIBULAR CONDYLE UNDER MECHANICAL STRAIN

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AIM: Core binding factor a1 (Cbfa1) is a crucial transcriptional factor for chondrocyte maturation and osteoblast differentiation in the mandibular condyle during natural growth. Type X collagen marks the onset of endochondral ossification in the condyle. It is important to understand tissue responses to different commonly used treatment modalities. Therefore, their expression in response to single-step and stepwise mandibular advancement could offer an insight into the effect of mechanical strain on condylar tissue. The aim of this study was to quantitatively assess the amount of mRNA expression of Cbfa1 and type X collagen in response to single-step and stepwise mandibular advancement.
MATERIALS AND METHOD: Four hundred and twenty 35-day-old female Sprague-Dawley rats were randomly divided into 20 experimental and 10 control groups corresponding to 10 time points. Experimental animals were either fitted with a single-step bite-jumping appliance with 4 mm mandibular advancement or stepwise bite-jumping appliance with 2 mm advancement initially and another 2 mm advancement after 30 days. The rats were sacrificed after 3, 7, 14, 21, 30, 33, 37, 44, 51 and 60 days. Mandibular condylar cartilages were dissected immediately under microscope and total

RNA was extracted. Cbfa1 and type X collagen mRNA were quantified with real-time RT-PCR.
RESULTS: Quantitative analysis demonstrated that Cbfa1 and collagen X mRNA expression for all three groups reached a peak on experimental day 21. Comparing single-step with stepwise advancement, expression of Cbfa1 and collagen X were consistently higher during the first advancement than the stepwise advancement. In response to the second mandibular advancement, both Cbfa1 and type X collagen levels were significantly higher than levels expressed in the single advancement and untreated controls.
CONCLUSION: Mandibular advancement promotes chondrocyte maturation and osteoblast differentiation by upregulating the level of Cbfa1. Stepwise advancement produces a higher level of Cbfa1 and type X collagen expression leading to more cartilage engaging in endochondral ossification.

200 ELASTIC SYSTEM FIBRES IN NORMAL HUMAN TEMPOROMANDIBULAR JOINT DISCS AND IN RELATION TO PATHOLOGICAL CHANGES

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AIM: It was hypothesized that elastic, elauinin and oxytalan fibres found in severely damaged discs appear in order to assure biomechanical compliance reinforcing the area devoid of collagen bundles thus functioning as shock absorbers of stretch and compression. The aim of this study was to investigate, histochemically, the elastic system fibres (ESF) in human temporomandibular joint (TMJ) discs with varying degrees of tissue degeneration/regeneration in order to evaluate whether there are differences that correlate with the histologic findings.
MATERIALS AND METHOD: Ten adult diseased human TMJ discs and two control specimens were studied histochemically by staining with Weigert's resorcin-fuchsin after oxidation with peracetic acid. This technique selectively stains both elastic, elaunin (pre-elastic), and oxytalan fibres. In order to confirm the presence and distribution of ESF, the specimens were also examined by transmission electron microscopy.
RESULTS: In TMJ discs with an abnormal collagen fibre arrangement, an increased number of oxytalan fibres could be observed, contrary to discs with scar-like tissue transformation in which oxytalan fibres were decreased in number. In discs showing tears and clefts, oxytalan fibres ran perpendicular to the defects, whereas elaunin and elastic fibres were mostly circumferentially arranged. Elastic, elaunin and oxytalan fibres were extensively detected in discs with chondroid metaplasia.

201 PREDICTION ON THE LONG-TERM CHANGES OF THE CURVE OF SPEE AFTER TREATMENT

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AIM: Prediction of the post-treatment development of the curve of Spee after treatment based on dental and skeletal parameters.
MATERIALS AND METHOD: In this retrospective study lateral cephalograms and study models of 100 subjects were taken before orthodontic treatment (T1; mean age 12.1 ± 1.6 years), after orthodontic treatment (T2; mean age 14.8 ± 1.5 years) and at least 3 years out of retention (T3; mean age 26.3 ± 5.0 years). Forty-seven subjects were treated with extraction of four premolars and 53 non-extraction. Curve depth (CD) and the location of the deepest point (LDP) of the curve were measured on the study models. The dental and skeletal parameters were assessed on lateral cephalograms using standard cephalometric analysis. Post-treatment changes in CD and LDP were correlated to these parameters using regression analyses.
RESULTS: When post-treatment curve development was predicted by pre- and post-treatment variables and changes during treatment, a deep curve at T2 was associated with deepening of the

curve between T2 and T3 (26 per cent) and a distal location of the LDP and protrusion of the lower anterior incisors at T2. Extraction therapy was associated with post-treatment mesial movement of the LDP (47 per cent). According to the regression analysis, there seems to be an optimal curve depth at T2 (1.9 mm) associated with the least amount of post-treatment change.
CONCLUSIONS: Post-treatment changes in the curve of Spee are correlated to the curve at the end of treatment. Pre-treatment curve and changes in the curve during treatment have little predictive value. It seems that the CD at the end of treatment should be 1.5-2.5 mm to achieve stability in CD after treatment.

202 IMPORTANCE OF PUMICE PROPHYLAXIS FOR ORTHODONTIC BONDING WITH SELF-ETCH PRIMER: AN *IN VIVO* STUDY

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AIM: Self-etching primers (SEP) have recently simplified the orthodontic bonding process and questions have arisen regarding their reliability and efficiency. The goal of this study was to assess the importance of a pumice prophylaxis prior to bonding with SEP (Transbond Plus) in reducing bond failures.
SUBJECTS AMD METHOD: Thirty orthodontic patients volunteered to participate in this split-mouth prospective clinical trial. A randomly assigned contralateral quadrant pattern allocated a pumice prophylaxis experimental group and a non-pumice control group of teeth within each patient. A total of 508 teeth were bonded and monitored over 3 months for bond failures. Bond failures were compared as the total number between groups and also as the number of patients who experienced bond failures with each method using Chi-square analysis.
RESULTS: There were 35 total failures (6.9 per cent) with six (2.4 per cent) in the pumice group and 29 (11.4 per cent) in the non-pumice group. There were statistically significant differences both in the total number of bond failures ($P < 0.001$) and in the number of patients with bond failures between groups ($P < 0.01$). A significantly lower and clinically acceptable bond failure rate was demonstrated when using Transbond Plus SEP after pumice prophylaxis.
CONCLUSION: There is strong evidence to suggest the need for pumice prophylaxis in orthodontic bonding when using SEP.

203 MECHANICAL PROPERTIES OF FIBRE REINFORCED COMPOSITE AND ORTHODONTIC TWISTED WIRES: FURTHER INVESTIGATIONS

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AIM: To investigate the effect of different span lengths, material type, and storage conditions on the flexural properties of orthodontic fibre reinforced composite (FRC) and stainless steel twisted retainers.
MATERIALS AND METHOD: Three different span lengths of both FRCs and stainless steel retainers (11.0, 8.0 and 5.0 mm) were investigated. Six specimens of FRCs (OrthoStick, StickTech, Turku, Finland) and six specimens of multistranded orthodontic wires (Penta One, Masel, Bristol, PA, USA) were prepared for each group. The FRCs were divided into four groups according to: a) different span length during the three-point bending test, and b) different storage modality: dry and wet (distilled water T = 37 degrees). From the load trials carried out, it was possible to derive the average curves of their mechanical behaviour.
RESULTS: The steel wires reached loads decidedly inferior and demonstrated more elasticity compared with the glass fibres. The fibres with a shorter span length supported greater loads but fractured earlier; the fibres with a greater span length supported lesser loads but demonstrated more elasticity and therefore were more similar to the steel wires. One difference in the results was observed in relation to the storage conditions of the fibres (wet or dry). The wet fibres achieved

inferior loads, showing characteristics similar to steel and demonstrated more elasticity compared with the dry fibres. For all tests there were no cases of complete fractures, only micro fractures clinically observable as white spots.
CONCLUSION: In patients who present aesthetic concerns or allergies to traditional wires, FRCs might represent an advantageous alternative for orthodontic retainers.

204 CLASS II MALOCCLUSIONS: MANDIBULAR GROWTH MODIFICATION AND THE TWIN BLOCK APPLIANCE

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AIM: To analyze the effects of Twin Block appliances on mandibular growth modification during the correction of Class II malocclusions.
MATERIALS AND METHOD: Lateral cephalograms of 22 female patients [study group (SG)] were obtained for each subject before (T1; mean age: 10.1 ± 0.6 years), and after (T2; mean age: 12 ± 0.3 years) active treatment. The SG had the following features: a Class II division 1 malocclusion due to a retrognathic mandible, of the same gender, the same race, no treatment had been carried out before the observation period. A control group of untreated patients, with an average age between 10 and 12 years (Michigan standard). Cephalometric analysis containing measures chosen from the analysis of Harvold was performed on each cephalogram: condylion-gnathion, menton-menton and condylion-menton. A paired *t*-test was used to compare the initial and final variables (T1-T2) of the SG and the *t*-test for independent samples to compare the variables between the two groups at 10 and 12 years of age. Statistical significance was tested at $P < 0.05$ and $P < 0.01$.
RESULTS: Treatment with Twin Block appliances resulted in a correction of the Class II malocclusion with a statistically significant difference in the increase of mandibular length ($P < 0.01$).

205 SUBJECTIVE SYMPTOMS, CHEWING ABILITY, AND PSYCHOSOCIAL EVALUATION OF PATIENTS REFERRED FOR ORTHOGNATHIC SURGERY

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AIM: To evaluate subjective symptoms, chewing ability, and psychosocial status in patients referred for orthognathic surgery and in control patients.
SUBJECTS AND METHOD: One hundred and fifty patients, divided into two groups, and matched according to gender and age. Group 1 comprised 100 consecutive patients previously examined at the Department of Oral Maxillofacial Surgery, Linköping and group 2 (the control group) consisted of 50 patients from the Public Dental Service clinic at Hageby, Norrköping. Each patient filled in a questionnaire with 17 questions relating to: aesthetic appearance, mandibular functioning, and symptoms of temporomandibular dysfunction (TMD) and pain. Patients 18 years and older also completed a standardized psychometric evaluation (SCL-90R).
RESULTS: In group 1, the subjective evaluation of the appearance of the face and teeth was significantly more negative than in group 2 ($P < 0.001$). The prevalence of pain in the face and jaws ($P < 0.001$), pain during movement of the jaws ($P < 0.01$), difficulties in opening the mouth ($P < 0.01$), and temporomandibular joint clickings ($P < 0.05$) was significantly higher in group 1 than in group 2. Higher values of impaired mandibular functioning, such as talking, eating raw carrots, and biting off food, were seen in group 1 compared with group 2 ($P < 0.001$). No significant difference in depression and somatization score (SCL-90R) was found between the groups.
CONCLUSION: Significant differences were found between the groups in evaluation of the aesthetic appearance of the face and teeth, several TMD-related symptoms, and mandibular functioning. Differences between the groups in the prevalence of depression or somatization were not significant.

206 INCISOR CHANGES FOLLOWING CLASS II DIVISION 1 TREATMENT

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AIM: To find examine the reduction in overjet in subjects treated with fixed appliances using both an extraction and non-extraction approach.
SUBJECTS AND METHOD: Class II division 1 subjects treated with fixed appliances (overjet > 5 mm) divided into three groups: 21 non-extraction treatment, 37 extraction of two upper premolars, 13 extraction of four premolars. Nineteen selected cephalometric dental, skeletal and soft tissue parameters corresponding to the position of the upper and lower incisors were measured on cephalograms taken before and after orthodontic treatment. A paired *t*-test was used to compare treatment changes of individual parameters in each group and one-way ANOVA to determine differences in initial conditions and treatment results among groups.
RESULTS: The largest overjet remained with non-extraction treatment (from 7.4 ± 2.4 mm to 3.7 ± 1.3 mm). Treatment overjet change in the two upper premolar extraction group was from 8.7 ± 2.8 mm to 2.7 ± 1.1 mm and in the four premolar extraction group from 7.0 ± 2.1 mm to 2.6 ± 0.9 mm. The main component of improvement was obtained by upper incisor retraction. With non-extraction treatment there was minor lower incisor protrusion, whilst in the four premolar extraction group the position of the lower incisors was not significantly changed. A small shift was observed in the basal bone relationship in the non-extraction treatment group (due to lower age and pubertal growth spurt). There were no significant differences in soft tissue changes between the three groups, who all exhibited a dorsal shift of the upper lip.
CONCLUSION: Dental changes were mainly responsible for the improvement in overjet. The detrimental effect of extraction treatment on soft tissue profile was not confirmed, and only a limited amount of skeletal change was found.

207 CEPHALOMETRIC VALUES MOST COMPATIBLE WITH A NORMAL OCCLUSION IN ADULT INDIVIDUALS.

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AIM: To determine cephalometric values that are most compatible with a normal occlusion.
MATERIALS AND METHOD: Twenty-six cephalometric parameters were measured in 110 adult individuals, selected with the only criterion of presenting a normal occlusion. From these individuals, those within 1 standard deviation (SD) for the parameter SNGoGn (n = 80) were selected, as were those within 1 SD for the variable: maxillo-mandibular angle (n = 76). Thus, individuals likely to have an ideal occlusion due to osseous or alveolar-dental compensations were excluded. The average between the measurements of both groups was determined. The figures obtained for the mean values, and those for the corresponding SD, were rounded to a single value.
RESULTS AND CONCLUSIONS: The mean values of the measurements of the groups did not show any significant differences with respect to each other, or those of the total sample. There were also no significant differences with respect to any of the values of the different groups.

208 QUALITY OF LIFE AND TEMPOROMANDIBULAR DISORDERS: THE EFFICACY OF ORAL SPLINTS

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AIM: During recent decades there has been a growing interest in quantifying those consequences of disease that affect a patient's life from the social and psychological point of view. This study was undertaken to evaluate the effects of temporomandibular dysfunction (TMD) therapy not only clinically, but also on the patient's quality of life. Moreover, a placebo was added to determine links between TMD and emotional conditions and to evaluate the real efficacy of traditional oral splints.

SUBJECTS AND METHOD: Twenty-four consecutive TMD patients (6 males, 18 females, ranging in age from 19 to 58 years) were evaluated both clinically and with patient-orientated tools. Two surveys were used: a generic questionnaire, the SF-36, commonly used to evaluate quality of life, and a disease-specific questionnaire, the Axis II of Research Diagnostic Criteria. Each TMD patient was asked to complete each questionnaire before starting therapy and two months after beginning therapy. The patients were randomly divided for therapy equal groups: one group were exposed to placebo therapy and the other group to gnathological treatment.
RESULTS: Before therapy, the questionnaires revealed that all TMD patients had high scores for depression, related to a low level of quality of life, both in 'physical pain' and in 'physical function' aspects. The post-therapy results showed that quality of life improved significantly, more so in the placebo group than in the gnathological therapy sample for physical pain.
CONCLUSIONS: These findings cast doubt on the therapeutic value of oral splints and suggest that in these patients the reduction in pain and improvement of quality of life is not due to a true therapeutic effect.

209 LONG-TERM BEHAVIOUR OF DIFFERENT ELASTOMERIC CHAINS

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AIM: New orthodontic materials enable a reduction of appointments during orthodontic treatment. For optimising the therapy, the long-term behaviour of elastomeric chains is a point of interest. In this study the long-term load transmission of different elastomeric chains was investigated.
MATERIALS AND METHOD: The force of the elastomeric chain was measured between two rings of the chain with different simulated inter-bracket distances. Registration of the measured values was implemented up to 56 days after the application of the elastomeric chains. Intraoral conditions were imitated. In a second examination dental movement was simulated.
RESULTS: The greatest loss of power (50-60 per cent) occurred in the first three days after application of the elastomeric chain. There was then a relative constant level of force for a longer period of time with an efficient force about >100 cN. With simulated tooth movement significant differences in the long-term load transmission between the different products was found. Some of the elastomeric chains lost their efficiency after a short time (Unitek Alastic, Ormco Powerchain), while others were more suitable for long-term use (Dentaurum Elastoforce, Forestadent FOR-Elastics, GAC Accuchain, Ormco Powerchain Generation 2).
CONCLUSION: For some products there is an indication that the force should be applied for a longer period of time. Between 3 to 28 days the elastomeric chains showed a constant level of force.

210 DENTOSKELETAL EFFECTS OF FUNCTIONAL THERAPY WITH A BITE-JUMPING APPLIANCE

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AIM: To analyse the orthopaedic and dentoalveolar effects of functional treatment by means of a bite-jumping appliance in patients with skeletal Class II malocclusions.
SUBJECTS AND METHOD: Eighty-nine patients with a skeletal Class II malocclusion. Forty-three (27 males, 16 females) were treated with functional therapy and 49 (27 males, 22 females) formed the untreated control group. The two samples were age, gender, and malocclusion matched. Dentoskeletal variables were measured and compared on lateral cephalograms taken before and at the end of the treatment/observation period (mean 14.8 months, SD 4.8 months). The pubertal growth spurt of the patients in both groups was assessed using the cervical vertebral maturation method.
RESULTS: No significant difference in skeletal variable changes were found between the treated and control group. On the other hand, there were significant differences in dentoalveolar variable changes between the treated and untreated subjects.
CONCLUSIONS: Functional treatment by means of a bite-jumping appliance is not effective ($P >$

0.05) in stimulating mandibular growth, whereas the dentoalveolar regions are influenced by this therapy.

211 NEWLY DEVELOPED SOFTWARE FOR THREE-DIMENSIONAL COMPUTED TOMOGRAPHIC RECONSTRUCTIONS AND VOLUME MEASUREMENTS

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AIM: To demonstrate the diagnostic possibilities of two modern imaging software systems in two siblings aged 7.5 and 10.6 years, with the rare disease pattern of cherubism. Different tissue types and structures as well as volume measurements of the facial anatomy can be selectively displayed in different colours according to specific density (Houndsfield units).
MATERIALS AND METHOD: InSpace® (Siemens AG, Medical Solutions, Forchheim, Germany) and VoXim® (IVS Solutions AG, Chemnitz, Germany) are two newly developed software programs for three-dimensional (3D) computer tomographic reconstruction and volume measurements. In the present investigation the density and volume of the affected mandibular bone was measured and data compared with unaffected patients. The InSpace-Viewer® was applied as an interactive 3D real-time examination tool based on volume-rendering technique for diagnostics.
RESULTS: The volume of the cystic mandible increased by a factor 1.93 in relation to unaffected patients, while the density of the cystic tissue showed 114.8 HU compared with 569.3 HU in unaffected tissues.
CONCLUSION: The major advantage of 3D software is the possibility to display complex craniofacial malformations and syndromes. Structural and morphological changes can be evaluated qualitatively and measured quantitatively. This makes universal application of the software interesting in different medical disciplines.

212 USE OF A MANDIBULAR ADVANCEMENT DEVICE IN ADULT OBSTRUCTIVE SLEEP APNOEA PATIENTS

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AIM: To investigate the effectiveness of an intra-oral mandibular advancement device in the treatment of patients with obstructive sleep apnoea (OSA) who could not tolerate or who had failed to comply with nasal continuous positive airway pressure (nCPAP).
SUBJECTS AND METHOD: Twenty-five adult patients with OSA all of whom had their diagnosis of OSA confirmed by overnight polysomnography. Lateral cephalometric radiographs and dental impressions for study models were obtained for all subjects. Each patient was fitted with an intra-oral mandibular advancement device. The criteria for treatment were sufficient dental retention for the appliance (>10 periodontically healthy teeth per arch) and the absence of temporomandibular dysfunction. The subjects were instructed to wear their appliances at night only. The efficacy of the appliance was assessed by the following investigations, performed at baseline and with the device: *in situ*: polysomnography, Epworth sleepiness scale, bed partner's assessment of snoring severity, patient's assessment of side-effects, and overall satisfaction.
RESULTS: The patients used their dental appliance during the first 6 months, on average, 7 hours/nights. The initial adverse effects gradually diminished following a few days of wear. All patients tolerated the appliance well and the mean apnoea-hypopnoea index and ODI values decreased significantly compared with the pre-treatment values. Treatment with the oral device improved daytime sleepiness and the Epworth sleepiness scale decreased.
CONCLUSIONS: The type of appliance used in this study can be recommended for those with mild OSA who are unable to tolerate nCPAP.

213 POSTERO-ANTERIOR CEPHALOMETRIC EVALUATION OF THE MANDIBLE IN CLASS II MALOCCLUSION PATIENTS

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AIM: To study on postero-anterior (PA) cephalograms the transversal and vertical morphology of the mandible in an Angle Class II group and to investigate possible mandibular differences between Class II and Class I individuals.
MATERIALS AND METHOD: Sixty-six PA cephalometric radiographs from 66 individuals, with a mean age 23.8 years. Thirty-three presented an Angle Class II malocclusion and 33 with an Angle Class I occlusion. Twelve linear and angular variables that define the morphology and symmetry of the mandible were evaluated. Statistical analysis as well as Student's *t*-tests were performed to determine any significant differences between the Class II and Class I groups. The error of the method was examined by double tracing of 30 radiographs.
RESULTS: The morphology and type of mandible was found to be significantly different in the two groups. The Class II sample presented a tendency to a vertical type compared with the normal Class I sample. The mandibular intermolar distance was significantly smaller in the Class II group and there was asymmetry of the mandibular corpus and ramus in the transverse plane. Significant asymmetry was also observed in the vertical plane in the Class II group concerning the occlusal plane and the cant of the mandible in relation to the upper face.
CONCLUSIONS: The mandibular morphology as well as the transversal and vertical components in the Class II group seem to present some significant differences compared with the Class I group.

214 HERBST/MULTIBRACKET APPLIANCE TREATMENT OF CLASS II DIVISION 2 MALOCCLUSIONS AT THE END OF GROWTH

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AIM: To evaluate the short- and long-term outcome of Herbst/multibracket appliance treatment in post-adolescent/young adult Class II division 2 subjects.
SUBJECTS AND METHOD: Sixteen young/young adult Class II division 2 malocclusion subjects (all with a distal molar relationship of ≥ ½ premolar width and a deep overbite) treated in two steps: Herbst appliance followed by a multibracket-appliance. Lateral head films in centric occlusion were analysed: before treatment (T1), after Herbst/multibracket appliance treatment (T2) and, on average, 2.4 years after treatment (T3). The sagittal-occlusion analysis (Pancherz, 1982) was used.
RESULTS: During T2-T1 all subjects were treated to a Class I molar occlusion with a normal overbite. The correction of the sagittal molar relationship amounted to 3.3 mm (comprising 2.6 mm skeletal and 0.7 mm dental changes). The overbite was reduced by 4.2 mm. During T2-T3 the molar relationship recovered by 0.8 mm (comprising 0.1 mm skeletal and 0.7 mm dental changes). The overbite recovered by 1.1 mm.
CONCLUSION: On a short- and long-term basis, Herbst/multibracket appliance treatment of Class II division 2 malocclusions at the end of the growth period is most successful.

Pancherz H 1982 The mechanism of Class II correction in Herbst appliance treatment. A cephalometric investigation. American Journal of Orthodontics 82: 104-113

215 WHICH TYPE OF DISTRACTOR TO USE FOR ALVEOLAR DISTRACTION?

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AIM: The devices currently available for alveolar distraction can basically be classified as intraosseous or juxtaosseous. In intraosseous distractors, the principal component runs through the bone segment, while juxtaosseous distractors are attached via plates directly to the maxillary surface. The aim of this retrospective comparative study was to compare the LEAD system intraosseous distractor (Leibinger) and the Modus juxtaosseous distractor (Medartis). All subjects who had undergone vertical alveolar distraction were considered with the aim of establishing the advantages

and disadvantages of each device.
SUBJECTS AND METHOD: Twenty-two patients (11 males, 11 females, mean age 44.6 ± 9.4 years) who underwent a total of 30 vertical alveolar distractions using the technique described by Chin and by García. A LEAD system was used for 23 distractions, and a Modus for the remaining seven distractions.
RESULTS: Lingual deviation of the transport fragment was observed in the most of LEAD system distractions but in none of the Modus distractions. The distraction screw interfered with the occlusion in 15 per cent of the LEAD system distractions and in 25 per cent of the Modus distractions.
CONCLUSIONS: The LEAD system facilitates asymmetric distraction, while correct distraction direction is maintained more effectively with Modus. Both types of distractor are effective for alveolar distraction. The selection of one or other will depend on the specific clinical characteristics of each particular patient and on the surgeon's experience.

216 METAL BRACKET ADHESION ON ENAMEL SURFACES: SHEAR BOND STRENGTH

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AIM: To compare the shear bond strength (SBS) of the retentive base of different metal orthodontic brackets.
MATERIALS AND METHOD: Fifty bovine incisors were inglobed into acrylic, leaving the labial surfaces exposed. Five types of orthodontic metal brackets were selected (1: Victory System, 3M Unitek; 2: Mini-Sprint, Forestadent; 3: Dyna-lock, 3M Unitek; 4: Topic, Dentaurum; 5: Equilibrium II, Dentaurum) and 10 samples of each type were used. The brackets were bonded on the previously cleaned and conditioned enamel surfaces with the same adhesive system (Transbond XT, 3M Unitek) and tested for SBS with an Instron universal testing machine. Data obtained in Newtons (N) and Megapascals (Mpa) were analysed with descriptive statistics, including means and standard deviations, and with ANOVA-Tukey HSD tests to analyse the intergroup significance. The adhesive fracture sites were classified with the Adhesive Remnant Index (ARI).
RESULTS: All specimens tested had SBS adequate to resist to orthodontic forces. Sample 5 showed significantly greater SBS (302.30 ± 90.14 N), when compared with the other samples, except for group 1. Specimens 1, 2 and 5 showed significantly greater SBS when the data were expressed in MPa (1: 30.48 SD 7.99 MPa; 2: 33 SD 6 MPa; 5: 29.07 SD 8.67 MPa). The ARI demonstrated large variability among the specimens although in groups 1 and 2 adhesive fracture sites were localized between the adhesive and enamel in 50 per cent of the tests.
CONCLUSIONS: The retentive structure of groups 1, 2 and 5 had equal validity. Enlargement of the retentive surface enhances adhesion but affects the adaptability to surface irregularity of the enamel, increasing the risk of fracture at the interface with the bracket.

217 CARIES LESIONS AFTER ORTHODONTIC TREATMENT FOLLOWED BY QUANTITATIVE LIGHT-INDUCED FLUORESCENCE: A TWO-YEAR FOLLOW-UP

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AIM: To monitor, with quantitative light induced fluorescence (QLF), the natural behaviour of white spot lesions detected directly after treatment with fixed orthodontic appliances, and two years post-treatment.
MATERIALS AND METHOD: The buccal tooth surfaces of 26 subjects (14 males, 12 females) were examined with QLF for the presence of caries directly after debonding (T0), 6 months (T1) and 2 years (T2) thereafter. The fluorescence loss [dF (per cent)] of lesions was determined for all lesions found using dedicated software (QLF 2.0 g, Research Systems BV, Amsterdam). Using QLF, 206 carious surfaces were recorded at debond. During the study 20 lesions were lost from QLF analysis:

16 lesions (dF T0 >25 per cent) in three subjects were restored and four were not analysed because of poor imaging. This resulted in 187 lesions that were included in this study with an average dF at T0 of 10.2 per cent (SD 4.9 per cent). Lesions varied from incipient (dF <10 per cent, n = 119) to advanced (dF >25 per cent, n = 5). Overall, lesions showed improvement at T1 ($P < 0.01$) but no further improvement at T2. Twenty-one lesions with dF at T0 varying from 5.1-18.3 per cent became significantly worse. The majority of lesions (n = 98, dF T0 5.2-32.5 per cent) were considered to be stable and 68 lesions (dF T0 5.6-27 per cent) improved significantly.
CONCLUSION: Lesions developed during orthodontic treatment have the ability to improve after appliance removal. Further research to investigate the potential of preventive measures to enhance lesion improvement is necessary.

218 ANOREXIA NERVOSA IN AN ANIMAL MODEL HAS A SIGNIFICANTLY NEGATIVE IMPACT ON THE QUANTITY AND QUALITY OF ALVEOLAR BONE

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AIM: Anorexia nervosa is characterized by patient-induced weight loss that leads to progressive malnutrition, sarcopenia and osteoporosis. It is more prevalent in females than in males (10:1). Amenorrhoea usually precedes weight loss and is one of the main diagnostic criteria of the disease. These patients are pathologically sensitive to their appearance and often seek orthodontic treatment, without the clinician's knowledge of the problem. This disease is known to result in significant deterioration of bone quantitative and qualitative characteristics. The aim of this study was to investigate the effects of this disease on the micro-architecture and density of alveolar bone.
MATERIALS AND METHOD: In a rat model, anorexia nervosa was simulated by a low-protein diet. In the rat, such a diet is known to cause amenorrhoea (oestrogen deficiency) after approximately 6 weeks. Twenty-two female rats (six-months-old) were pair-fed either a low-protein (2.5 per cent casein) or a standard (15 per cent casein) diet for 16 weeks, forming the low-protein (n = 11) and the control (n = 11) group, respectively. At the end of the experiment the animals were sacrificed and their left hemi-mandibles were excised. Bone mineral density (BMD) and bone microstructure parameters of the alveolar process were measured using dual-energy X-ray absorptiometry and micro-computed tomography. The alveolar process height was also measured.
RESULTS: Protein malnutrition led to significant reduction of BMD of the molar alveolar process ($P < 0.05$). It also resulted in significant decrease of bone volume fraction (volumetric density) ($P < 0.01$) and both trabecular ($P < 0.05$) and cortical ($P < 0.001$) thickness. The height of the alveolar process was not influenced.
CONCLUSIONS: Based on the findings of this study and the absence of relevant clinical investigations, it is suggested that orthodontic treatment of patients suffering from anorexia nervosa probably present certain abnormalities due to the adverse effect on alveolar bone remodelling.

219 AESTHETIC EVALUATION OF THE PROFILE USING DIGITAL IMAGING

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AIM: To evaluate the aesthetic perception of the lower facial third in profile in a series of photographs modified by a computer program (Nemoceph, Nemotec Co., Spain) with the aim of determining which profile was the most aesthetically pleasing in Galicia.
MATERIALS AND METHOD: Ten lateral photographs of five male and five Caucasian females were selected to obtain five distinct types of profile that corresponded to the following: Class I; Class II caused by a protrusive maxilla; Class II caused by a retrusive mandible; Class III caused by a retrusive maxilla; Class III profile caused by a protrusive mandible. Once the profiles were obtained a survey of different Galician professionals with an interest in aesthetics (general dentists, orthodontists, maxillofacial surgeons, and lay people) was carried out. In order to qualitatively assess the lateral

photographs, a scale from 0 to 5 was used with the least aesthetic profile corresponding to a score of 0 and the most aesthetic to 5.
RESULTS: A Class II profile was seen as the most aesthetically pleasing in females while a Class III was less accepted. On the contrary a Class III was more accepted in males and a Class II was less popular amongst those surveyed.
CONCLUSION: There does not appear to be a relationship between a profile displaying characteristics considered to be normal from an orthodontic perspective and those preferred by lay people. There are, however, marked differences in the subjective perception of malocclusion in both males and females.

220 TEMPOROMANDIBULAR JOINT INVOLVEMENT VERSUS SIGNS OF PARAFUNCTIONS IN JUVENILE IDIOPATHIC ARTHRITIS

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AIM: Chronic inflammatory arthritis in children under 16 years persisting for at least 6 months is termed 'juvenile idiopathic arthritis' (JIA), if other conditions can be excluded. Previous investigations have reported a high prevalence of temporomandibular joint (TMJ) involvement. The aim of this study was to investigate if a statistically significant correlation exists between parafunctions and TMJ disorders.
SUBJECTS AND METHOD: Forty-five patients with JIA (32 females, 13 males) with a mean age of 13.5 years (range 3-19 years) were examined for TMJ disorders by manual functional analysis (Bumann and Landeweer). The patients were subdivided into pauciarticular (< 4 joints involved) and polyarticular (> 5 joints involved) JIA. The clinical diagnosis 'arthropathy' was the umbrella term for osseoarthopathic changes of the condyle, internal derangement and capsulitis. Under parafunctions the following signs were evaluated: buccal mucosa ridging, tongue indentation, bruxism, tooth abrasions, wedge-shaped defects, premature contacts, Stillman clefts, localised gingival recessions and masticatory muscle pain.
RESULTS: Children under 7 years were excluded from the analysis because of lack of reproducibility of the examination. The TMJ was involved in 37 per cent (n = 14) of the remaining 38 participants, most severely (but not statistically significant $P = 0.082$) in polyarticular JIA. Seventy-one per cent (n = 27) of the patients had symptoms of parafunctions. The chi-quadrant test (p = 0.715) showed no statistical correlation between signs of parafunction and TMJ disorders.
CONCLUSION: JIA patients with parafunctions carry no higher risk for TMJ involvement. Polyarticular JIA seems to be associated with TMJ disorders. Because no statistical correlation could be found, all patients with JIA should undergo regular TMJ evaluation.

221 THE 'DIVINE PROPORTION'' IN PATIENTS WITH A SKELETAL OPEN BITE

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AIM: Skeletal open bite subjects have, by definition, a greater than average face height. The aim of this study was to evaluate the vertical divine proportion in patients exhibiting an open bite, in order establish possible relationship between NL/ML angle and vertical proportions in total and lower face.
MATERIALS AND METHOD: Lateral cephalograms from two groups of patients with a skeletal open bite: group 1: NL/ML angle range 30-35 degrees (28 patients, mean age 14 years.); group 2: NL/ML angle ranging from 36 degrees, upwards (10 patients, mean age 15 years.); a control group with a NL/ML angle range 25 ± 1 degree (10 patients, mean age 16.6 years). The allocation to each group was based on Björk's analysis, statistically significant in the paired t test. The vertical divine proportions estimated in all groups were: pupil-subnasale/subnasale-menton and subnasale-stomion/stomion-menton.

RESULTS: In the control group 50 per cent presented optimal divine proportions, 40 per cent an increased subnasale-menton and 10 per cent a shortening of lower face. In group 1, 10 per cent exhibited optimal divine proportions, 50 per cent an increased lower face height and 40 per cent a shortening of the lower face. In group 2, no patients had a divine proportion; all exhibited elongation of the lower face. In all groups, open bite and control, there was elongation of the lower part of the face (stomion-menton). The correlation between NL/ML and an increased lower face height was greater in patients with an angle larger than 34 degrees.
CONCLUSIONS: The divine proportion parameter measured on soft tissues does not always correlate with hard tissue parameters. Extreme changes in the hard tissues are seemingly not compensated by the soft tissues.

222 JARABAK INDEX VERSUS THE MANDIBULAR PLANE IN THE DETERMINATION OF FACIAL GROWTH DIRECTION

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AIM: The Jarabak index (FHR) has been used, along with other measurements, to distinguish different facial types, often in conjunction with the inclination of the mandibular plane (SNGoGn). As FHR has several points in common with SNGoGn, the aim of this study was to determine which better reflects individual growth direction.
SUBJECTS AND METHOD: One hundred and ten young adults with normal occlusion were selected, and 12 cephalometric parameters, with the capacity to discriminate alterations in vertical growth, were measured. The sample was further divided, separating the more horizontal individuals, those of average typology, and those that were more vertical, for each of the measurements, with reference to the averages and standard deviations obtained.
RESULTS: FHR showed a negative correlation ($P < 0.001$) with inclination of the mandibular plane. A simple linear regression analysis may represent the regressions by means of the equation: FHR = 92,88591-0,80785 × SNGoGn (r = –0.9534). SNGoGn showed a high discriminatory power in all three groups, whatever measurement was used.ifferentiate; this being the only variable showing such a characteristic. The variance analysis rendered a Snedecor F value of 153.83 for SNGoGn and 89.80 for FHR.
CONCLUSIONS: FHR is likely to undergo modification as a result of changes in the anteroposterior situation of the osseous bases; SNGoGn was the only measurement whose magnitudes did not change.

223 CLINICAL EVALUATION OF A GLASS IONOMER CEMENT FOR ORTHODONTIC BONDING

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AIM: To assess *in vivo* the clinical performance and bond failure rates of brackets bonded with a resin-modified glass ionomer cement (Fuji-Ortho™). The two different bonding methods recommended by the manufacturer were compared.
SUBJECTS AND METHODS: A single centre, split-mouth, prospective randomised controlled clinical trial (RCT) following the recommendations of the CONSORT statement was carried out in a hospital-based orthodontic department. Forty-eight consecutive patients (25 females, 23 males) requiring upper and lower fixed appliance therapy with or without extractions were enrolled. A total of 836 teeth were bonded with 'A' Company Andrews prescription brackets. Half the brackets were bonded using an etched (conditioned) technique whilst the other half was bonded using a moist, non-etched procedure. The site and time to initial bond failure during the first 6 months of treatment was recorded and survival analysis performed. The Aesthetic Remnant Index was used to assess the amount of resin remaining on the enamel surfaces.
RESULTS: The bond failure rate for the etched method was 4.8 per cent and 6.9 per cent for the non-etch technique. The majority (77 per cent) of failures during the initial 6 months of active treatment

occurred at the enamel-adhesive interface.
CONCLUSIONS: Both bonding methods exhibited acceptable bracket failure rates during the initial 6-month period. The study will continue to completion of active treatment when a true survival analysis will be carried out. These results will be compared with those of an earlier completed RCT which looked at the clinical performance of etched Fuji-Ortho™ and a composite resin (Rely-a-Bond™) orthodontic bonding agent.

224 WILL 'SETTLING OF THE OCCLUSION' DURING THE RETENTION PERIOD AFTER FIXED APPLIANCE THERAPY IMPROVE FUNCTIONAL OCCLUSION?

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AIM: To analyse any possible changes in functional occlusion after fixed appliance therapy, when comparing the findings directly after appliance removal with those at least one year later.
SUBJECTS AND METHOD: Fifty consecutive subjects (20 males, 30 females) who had undergone two-arch fixed appliance treatment (Tip-Edge) were examined clinically, directly after removal of the fixed appliance and at the end of retention almost two years (mean = 22 months) after treatment. Occlusal slides between retruded contact position (RCP) and intercuspal position (ICP) in antero-posterior and lateral directions, as well as posterior tooth contacts on protrusion and non-working side contacts on lateral mandibular excursions, were recorded.
RESULTS: Directly after appliance removal nine subjects (18 per cent) had a good functional occlusion (neither RCP/ICP interferences, nor posterior contacts on protrusion or non-working side contacts on lateral mandibular excursions) while after the retention period 15 subjects (30 per cent) had a good functional occlusion. The RCP/ICP interferences in the anterior direction improved in 30 per cent, worsened in 10 per cent and remained unchanged in 60 per cent of the subjects, whereas those in lateral directions improved in 20 per cent, worsened in 12 per cent and remained unchanged in 68 per cent. Concerning tooth contacts on protrusion, 10 per cent of the subjects improved, 12 per cent worsened and 78 per cent remained unchanged. For lateral mandibular excursions 6 per cent improved, 6 per cent worsened and 88 per cent remained unchanged.
CONCLUSION: Directly after removal of the fixed appliance more subjects (82 per cent), had an unsatisfactory functional occlusion than after a retention period of almost two years (70 per cent). Nevertheless, in spite of some improvement, functional occlusion cannot be expected to improve markedly due to 'settling of the occlusion' during the retention period.

225 PEER ASSESSMENT RATING OF LINGUAL TREATMENT OUTCOME

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AIM: Orthodontic therapy with lingual appliances is reported to be difficult and some clinicians find it very demanding to achieve the same degree of treatment quality for labial and lingual appliances. The aim of this investigation was to retrospectively assess the outcome of orthodontic treatment using lingual appliances.
MATERIALS AND METHOD: The pre- and post-treatment casts of 50 consecutive patients treated and finished with lingual brackets in the upper and lower arch were evaluated using the Peer Assessment Rating (PAR) Index.
RESULTS: Twenty-eight patients had missing teeth or were treated with extractions. Seven underwent orthognathic surgery in combination with orthodontic treatment. The average treatment time was 25 months. Treatment time was longest in patients with a Class II division 2 malocclusion and shortest in those with a Class I malocclusion. The initial PAR score for all patients averaged 22.2. Patients with a Class II division 1 malocclusion showed the highest, those with a Class I malocclusion the lowest values. Orthodontic therapy with a lingual appliance led to an almost perfect occlusion in 47 patients, only two patients had a final PAR score over 10. This great improvement was seen for all Angle Classes.

CONCLUSION: Lingual orthodontics offers an invisible treatment option and is therefore an alternative to conventional fixed appliance therapy for aesthetically demanding adult patients. The final PAR scores show that very good results can be achieved with lingual appliances.

226 LIP PRESSURE MEASUREMENTS BEFORE AND AFTER ORTHODONTIC TREATMENT**

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AIM: Diagnostic material for orthodontic cases mainly deals with the hard tissues. The quality of orthodontic treatment is, however, greatly affected by the soft tissues. Soft tissues, including the lips and peri-oral musculature, have not previously been adequately evaluated by objective means. The lip pressure gauge is a device to objectively measure the pressure of the lips and peri-oral musculature against the dentition. The aim of this study was to compare pre-and post-treatment lip pressure measured with this device.
SUBJECTS AND METHOD: Angle's Class I, II and III subjects were selected. In addition subjects who had undergone orthognathic surgery for the correction of skeletal mandibular prognathism were included. The lip pressure gauge was used to measure the maximum pressure of the upper and lower lips before and after treatment. Comparison was carried out with measurements obtained of lip pressure and ratio of 511 normal subjects (Nakao, 2002).
RESULTS: Patients who exhibited a lack of balance between upper and lower lip pressures showed a significant improvement after treatment. Lip pressure harmony was restored.
CONCLUSION: Orthodontic treatment improves the form as well as the function of the soft tissues. The favourable transitions can be measured using the lip pressure gauge and the results compared on the basis of numerical values.

227 MANDIBULAR GROWTH ROTATIONS: WILL WE EVER BE ABLE TO PREDICT THEM ACCURATELY?

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AIM: To assess the ability of sophisticated statistical methods (multilevel modelling) to predict mandibular rotations from cephalometric and demographic data.
MATERIALS AND METHOD: Cephalometric data was collected over six time points for 50 subjects from the Bhatia and Leighton (1993) growth study. The cephalometric parameters to be measured were determined by principle components analysis using previously collected data (Khalil, 1999) to avoid the problem of collinearity. The mandibular rotation that had occurred between radiographs was assessed using the structural method of Björk. Subjects were not included if they had received orthodontic treatment, but were included if they had teeth extracted (11 of 50 subjects). The six time bands ranged from age 7-9 to 18 years plus to ensure that the pubertal growth spurt and usual orthodontic age were included for all subjects. The male:female ratio was 2:1. The data were prepared (SPSS) and entered into the MLwiN software program. A multiple regression model was generated with 'mandibular rotation' as the dependent variable
RESULTS: Inter-individual variation was large. The model indicated that gender was the most important determinant of mandibular rotation over all time points, with males experiencing more anterior rotation than females ($P < 0.01$). When both gender and upper anterior dental height were added to the model as explanatory variables, the predictive effect was slightly enhanced. However, the overall predictive effect of the model remained relatively weak.
CONCLUSION: The use of multilevel modelling enabled a more accurate prediction of mandibular rotation than reported previously. However, even with the use of sophisticated statistical methods, the predictive power is likely to be too weak to be of clinical use.

228 DELAYED MATURATION OF CHONDROCYTES ENHANCES CONDYLAR GROWTH

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AIM: Delayed maturation of chondrocytes allows the mesenchymal cells to reach their full replication capacity of (38 ± 4 cycles). SOX9 and PTHrP genes are known to regulate chondrocyte differentiation and delay maturation respectively. The aim of this study was to investigate the temporal pattern of PTHrP and SOX9 gene expression in the mandibular condyle during functional appliance therapy by two different treatment regimens, one- and two-step advancement.
MATERIALS AND METHOD: Gene expression was determined using real-time RT-PCR on a rat model with three randomly allocated groups (control, 1-step and 2-step). Fixed functional appliances were fitted to position the mandible 4 mm forward in the 1-step group. For the 2-step group 2 mm mandibular advancement was achieved at the beginning followed by another 2 mm advancement on day 30. The animals were sacrificed on experimental day 3, 7, 14, 21, 30, 33, 37, 44, 51 and 60. Total RNA was extracted from the mandibular condyle for PTHrP and SOX9 genes quantification.
RESULTS: Both PTHrP and SOX9 expression was fairly constant in the control group throughout the whole experimental period. The PTHrP and SOX9 genes expression was increased and reached the peak level on the seventh day after functional appliance insertion, then it gradually returned to the baseline level in the 1-step group. In the 2-step group, a similar expression pattern as in the 1-step group for both genes was noted but with a smaller magnitude, moreover, the second advancement on day 30 triggered a significant increase leading to another peak increment on day 37.
CONCLUSION: Functional appliance therapy increases the expression of regulatory genes that delay maturation of chondrocytes thus allowing the mesenchymal cells to reach their full replication capacity and subsequently enhance condylar growth. Stepwise advancement re-activates condylar growth through re-triggering the same cascade of events.

229 QUANTITATIVE EXPRESSION OF INDIAN HEDGEHOG GENE USING REAL-TIME POLYMERASE CHAIN REACTION

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AIM: Quantitative real-time reverse transcription polymerase chain reaction (RT-PCR) technology is an invaluable new tool to measure messenger RNA expression *in vivo* and *in vitro* to screen for tumour markers, diabetic glomerulosclerosis and other cytotoxicology tests. Indian hedgehog (Ihh) acts as a mechanotransduction mediator that converts mechanical signals resulting from anterior mandibular displacement to stimulate cellular proliferation on cartilage formation. In this study to help in understanding tissue responses to functional appliance therapy, quantitative RT-PCR measurements were carried out to: 1) investigate the temporal pattern of gene expression of Ihh and type II collagen in the condyle during mandibular advancement, and 2) quantify and compare Ihh and type II collagen mRNA expression during natural growth, single-step and stepwise advancement of mandible.
MATERIALS AND METHOD: Sprague-Dawley rats were fitted with bite jumping appliances for either single advancement or stepwise advancement of the mandible. Animals of the experimental groups, together with their matched controls were sacrificed 3, 7, 14, 21, 30, 33, 37, 44, 51 and 60 days after appliance insertion. Total RNA was extracted from condylar cartilage immediately after dissection under a microscope. Ihh and type II collagen mRNA was quantified using RT-time PCR.
RESULTS: In the single step group, Ihh mRNA expression reached a peak on experimental day 7 and gradually decreased to the control level. In the stepwise advancement group, Ihh mRNA significantly increased on day 7. However, the second advancement resulted in another peak on experimental day 37.
CONCLUSIONS: Mandibular advancement triggers and enhances the expression of the Ihh gene, the mechanotransduction mediator that leads to more cartilage formation and acts as a template for new bone formation. Stepwise advancement of the mandible delivers mechanical stimuli that produce a

series of tissue responses and lead to more chondrocyte proliferation, greater volume of cartilage and eventually more bone formation.

230 EFFECTIVENESS OF CEPHALOMETRICS IN ORTHODONTIC TREATMENT PLANNING

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AIM: To determine the effectiveness of cephalometrics in orthodontic treatment planning.
MATERIALS AND METHOD: Diagnostic records of 48, 11-14-year-old subjects with Class II division 1 malocclusions were divided in to two groups, stratified on gender, age, occlusion and overjet. The cephalograms were digitized twice and the mean values of the measurements were used. In a crossover design the records were assigned to one of two combinations: 1. dental cast only and 2. dental cast, cephalogram and cephalometric values. The records were presented in a random order to postgraduate students for formulation of orthodontic treatment plans containing a dichotomous decision regarding use of growth modification, rapid maxillary expansion (RME) and extraction. After the first recordings, diagnostic records were relabelled and reordered at random for repetition of treatment planning, based on alternative combinations.
RESULTS: The median strength of intra-examiner agreement was moderate to substantial and for inter-examiner agreement fair to substantial. Despite diagnostic record effect, recording effect and/or diagnostic record–recording interaction, no statistically significant difference in the median portion of agreement between treatment planning using both combinations was present. The proportion of agreement was over 70 per cent for growth modification, over 80 per cent for extraction and over 90 per cent for RME. Considering interaction between treatment options, proportion of agreement was still over 55 per cent.
CONCLUSION: Variation exists in orthodontic treatment planning for Class II division 1 malocclusions. Significance of cephalometrics in treatment planning was found to be below 10 per cent for RME, below 20 per cent for extraction and below 30 per cent for growth modification. Considering interactions in total, it was below 45 per cent.

231 DIFFERENTIATING ACTION OF TRIETHYLENE GLYCOL DIMETHACRYLATE ON HL-60 CELL LINE

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AIM: Triethylene glycol dimethacrylate (TEGDMA) is present in self- and/or light-cured orthodontic composite resins, and is partially released, after polymerization, in the oral cavity. The aim of this study was to evaluate the differentiating effect of TEGDMA on promyelocytic cell line HL-60: the latter, during differentiation, stop growing and acquire the ability to form reactive oxygen species as shown by the appearance of respiratory burst (ROS) stimulated by Phorbol12-Myristate13-Acetate (PMA).
MATERIALS AND METHOD: Cell number was determined using the trypan blue dye exclusion test. HL-60 exponentially growing cells (20 0000 cells/mL) were set at day 0 in RPMI 1640 medium containing the differentiating agent All-trans Retinoic Acid (ATRA; 0.001 mmol/L) or different concentrations of TEGDMA (from 0.0031 to 4.65 mmol/L). ROS production was studied by chemiluminescence (CL) tests after 5 days of incubation. CL system (1.00 mL of final volume with modified Krebbs Ringer Phosphate solution) contained: 100 nmoles of luminol, untreated cells used as control (100 000) or cells treated with ATRA or with the monomer, in the presence or absence of 1.50 nmoles of PMA. For the analysis the treating index was considered: area of signal produced by treated cells/area of signal produced by untreated cells.
RESULTS: TEGDMA showed a significant decrease in cellular proliferation rate with respect to the control at concentrations from 0.09 to 0.38 mM. This effect was independent from cellular mortality

whereas at concentrations greater than 0.38 mM a cytotoxic effect was present. ATRA showed a cytostatic effect. CL analysis demonstrated that HL-60 cells recover ROS production after treatment with TEGDMA at concentrations greater than 0.19 mM.
CONCLUSION: The findings show the differentiating action of TEGDMA. Further studies are necessary to clarify its mechanism of action.

232 BIOCHEMICAL ACTION OF TRIETHYLENE GLYCOL DIMETHACRYLATE ON HL-60 CELL LINE

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AIM: The cytotoxic action of triethylene glycol dimethacrylate (TEGDMA), which is a methacrylic monomer present in orthodontic composite resins, has been shown previously. The aim of this study was to investigate the biochemical bases of TEGDMA cytotoxic behaviour.
MATERIALS AND METHOD: Glucose consumption and enzymatic activity of glucose-6-phosphate dehydrogenase and glutathione reductase: HL-60 cells (200000 cells/mL) were set in RPMI 1640 medium containing All-trans Retinoic Acid (ATRA, 0.001 mmol/L) used as control or TEGDMA (0.38 mmol/L). Cellular glucose consumption was measured in culture supernatants (after 24 and 48 hours of incubation) using a Hitachi 917 automatic analyzer and the appropriate reagent kit. Enzymatic activities were determined from whole cell extracts through an Olympus AU 400 analyzer and the appropriate reagent kits. Oxygen consumption in intact cells and in isolated mitochondria: HL-60 cells were set in RPMI 1640 medium containing ATRA or TEGDMA and incubated for 1 hour at room temperature. Oxygen consumption was measured using an oxygraph (Oxygen meter Model 781, IS) equipped with a Clark electrode. The rate of oxygen utilization was monitored for 10 minutes (basal respiration) on intact cells. The isolated mitochondria (0.5 mg/ml) were analyzed in a respiratory medium and energized with succinate and rotenone.
RESULTS: Cells treated with TEGDMA showed a significant increase in glucose consumption compared with cells treated with ATRA. In the presence of TEGDMA enzymatic activity increased, in a statistically significant way compared with cells treated with ATRA. The oxygen consumption decreased in the presence of TEGDMA both on intact cells and in isolated mitochondria
CONCLUSION: The obtained data demonstrate the complexity of the interaction between TEGDMA and cellular metabolism: in fact the alteration of mitochondrial functionality forces the cells to increase glucose consumption for the production of ATP and NADPH, which is necessary for the glutathione reduction.

233 TREATMENT OUTCOME IN UNILATERAL CLEFT LIP AND PALATE EVALUATED WITH THE GOSLON YARDSTICK: A META-ANALYSIS

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AIM: Since a high variety of treatment protocols for children with cleft lip and palate exist, clinicians face the difficult task in selecting those treatment options that contribute to the optimal delivery of care. The aim of this study was to assess determinants for treatment outcome in unilateral cleft lip and palate (UCLP) rated according to the Goslon yardstick and 'Goslon-like' 5-year-index by means of a meta-analysis.
MATERIALS AND METHOD: Multiple databases were searched for publications in which patient groups were evaluated by Goslon ranking or by the 5-year-index. Based on the inclusion criteria, 15 papers were selected and the following background variables could be extracted that were evaluated as determinants for treatment outcome in UCLP: year of birth, average age of the patients, racial background, presence of Simonart's band, use of infant orthopaedics, palatal closure before the age of 3 years versus palatal closure at a later age, alveolar bone grafting and number of surgeons.

RESULTS: The total number of patients included in the meta-analysis was 1236. The only background variable with a significant ($P = 0.003$) influence on the treatment outcome was the timing of palatal closure: patients whose soft and hard palate were closed before the age of 3 years presented poorer Goslon scores (mean score 2.9, SD 0.4) than those whose hard palate closure was performed at a later age (mean score 2.3, SD 0.2). Only 4 per cent of the delayed palatal closure patients were allocated a Goslon score 4 or 5 versus 29 per cent in the early palatal closure group: in case of early palatal closure 25 per cent more patients required complex orthodontics or an orthodontic-surgical approach.
CONCLUSIONS: Delayed palatal closure generally results in improved dental arch relationships than early palatal closure. Well-designed randomised clinical trials are required for further investigation into the optimal timing for palatal closure.

234 *IN VITRO* EVALUATION OF THE FRICTIONAL FORCES BETWEEN BRACKETS AND ARCHWIRE

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AIM: To evaluate, *in vitro*, the frictional forces between bracket and archwire in an apparatus including three self-ligating brackets (Damon2, SDS and Ormco)
MATERIALS AND METHOD: The tested brackets were singly bonded to a brass medium using a preformed 0.021 × 0.025 inch stainless steel wire jig in order to exclude adverse tipping or torsion moments. Every bracket was positioned in the 3-bracket apparatus. The central bracket was positioned 1 mm higher than the others, so that the three brackets were not vertically aligned. Every 3-bracket-apparatus was tested with the same wire: Copper NiTi 0.014 (SDS-Ormco). A device was designed and constructed to measure the frictional forces (IPCF of CNR Messina, Italy). Twelve 3-self-ligating-bracket apparatuses were tested. For the control two sets of twelve 3-bracket-self-ligating apparatuses with opened slide and conventional ligation were tested. Stainless steel ligature wire was used in the former and elastomeric modules in the latter.
RESULTS: One-way analysis of variance showed a significant ligation mode effect on the frictional property of the tested 3-bracket apparatus ($P < 0.001$). *Post hoc* pairwise comparison showed that the frictional forces resulting from passive self-ligation were significantly lower than those resulting from elastic ($P < 0.01$) and metal ($P < 0.01$) ligation. *Post hoc* comparison showed no significant difference between elastic and metal ligation.
CONCLUSION: Self ligating brackets offer less resistance than normal ligation.

235 EFFECT OF INCREASED MASTICATORY FUNCTION ON THE TRANSVERSE CRANIOFACIAL MORPHOLOGY OF ADULT RATS

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AIM: To experimentally investigate the effects of increased masticatory function on the craniofacial morphology in adult rats with an earlier reduced masticatory muscle function.
MATERIALS AND METHOD: Sixty-six young male rats were used. The experimental group received a soft diet for a prolonged period, so that the animals developed weak masticatory muscles. A control group received ordinary food during the whole experimental period (27 weeks). After 21 weeks, when the animals had nearly ceased body growth, the rats in the experimental group were divided into two groups. One group continued with a soft diet until the end of the experiment (Pure soft diet group). The other group received ordinary food to allow the possibility of retraining their masticatory muscles (hard/soft diet group). At week 21 and at the end of the experimental period (week 27) axial cephalograms were taken. Seven transverse distances were measured.
RESULTS: At week 21 the premaxillary width, the anterior zygomatic width and the width between the anterior and lateral point of the zygomatic processes were statistically significantly smaller in the

soft diet group than in the control group. At week 27 the anterior zygomatic width and the width between the anterior and lateral part of the zygomatic processes were statistically significantly smaller in the soft diet group than in the control group. Similar results were found when the hard/soft diet group was compared with the control group. The comparison between the hard/soft diet group and the soft diet group at week 27 revealed only one statistically significant difference in the anterior zygomatic width, which was smaller in the soft diet group than in the hard/soft diet group.
CONCLUSION: Masticatory muscle function seems, to some degree, to influence the transversal craniofacial morphology of adult rats in areas under direct muscle loading.

236 PRE-SURGICAL INTRA-ORAL RETRUSION IN BILATERAL CLEFT LIP AND PALATE PATIENTS

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AIM: To analyze maxillary arch dimensions in patients with complete bilateral cleft lip and palate (BCLP) treated with an intra-oral retrusion plate prior to lip closure.
MATERIALS AND METHOD: The effects of the intra-oral retrusion plate were evaluated on serially obtained maxillary casts of 14 complete BCLP patients.
RESULTS: The *t*-test for dependent observations showed a significant decrease in the distance between the premaxilla and the cleft lateral segments during active treatment. This decrease correlated with an increase in the deviation of the premaxilla in relation to the vomer. For each millimetre decrease in distance between the premaxilla and the cleft lateral segments, an average increase in deviation of 4.0 degrees was found. Left and right cleft widths decreased significantly, premaxillary width increased significantly and transverse dimensions did not change significantly.
CONCLUSION: Active pre-surgical treatment with an intra-oral retrusion plate induces a significant decrease in distance between the premaxilla and the lateral segments. This decrease is frequently accompanied by an increase in deviation of the premaxilla relative to the vomer.

237 COMPARISON BETWEEN INTRAORAL AND STUDY CAST MEASUREMENTS IN THE ASSESSMENT OF MALOCCLUSION

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AIM: To evaluate the reliability of intraoral measurements that compute a malocclusion index score to determine malocclusion severity in the permanent dentition.
SUBJECTS AND METHOD: The research was a part of the longitudinal study in Slovenia on a sample of 530 three-year old children. At 14 years of age (mean 14.8 years, SD 0.18), a cohort of 92 children (44 boys, 57 girls) were selected at random in a cross-sectional study. Quantitative registrations of space and occlusal anomalies were performed intraorally as well as on study casts. Kappa (κ) statistics were used to evaluate agreement between clinical and study cast malocclusion assessment. Systematic bias of measurements was tested using Wilcoxon's signed rank test.
RESULTS: Complete agreement between the two measurements was found for anterior crossbite, open bite, transverse occlusion of the posterior teeth and crowding ($\kappa = 1$); excellent reliability for rotation, for buccal segment relationship, overjet and axial inclination of teeth ($\kappa = 0.61–0.80$), moderate agreement for overbite, midline deviation and vestibular eruption of canine ($\kappa = 0.41–0.60$). Intraorally small, but statistically significant scoring of axial tooth inclination was identified ($P = 0.028$). Overall classification into severity grades, based on total malocclusion score, showed excellent agreement between the two methods ($\kappa = 0.89$), without statistically significant bias.
CONCLUSIONS: Malocclusion assessment, recorded and measured intraorally, is as reliable as assessment on study casts. The proposed method can be used in screening, in epidemiological studies, and in clinical orthodontic assessment.

238 DOES ORTHODONTIC TREATMENT CHANGE THIRD MOLAR POSITION AND ERUPTION SPACE?

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AIM: To investigate the effects of two different orthodontic treatment modalities; first molar extraction or non-extraction treatment, on the position and eruption space of the third molars.
MATERIALS AND METHOD: Standardized panoramic radiographs of 41 female subjects ranging in age from 14 to 20 years. Twenty-one were orthodontically treated with the extraction of first permanent molars and 20 without extractions. Panoramic radiographs taken at the start and the end of treatment were traced, and positional changes, eruption space and eruption path of the third molars were evaluated using linear and angular measurements. Data were analyzed statistically and the independent samples Student's *t*-test was used for comparison between the groups.
RESULTS: Linear variables demonstrated a statistically significant difference between the two groups for third molar eruption space. In the permanent first molar extraction cases, the mean value of the third molar eruption space was larger than that in the non-extraction cases. No statistically significant differences were found between the groups for the angular variables.
CONCLUSION: Orthodontic treatment accomplished with the extraction of four permanent first molars increases the eruption space for third molars.

239 COMPARISON OF TOOTH SIZE DISCREPANCIES AND THE EFFECT OF PREMOLAR EXTRACTIONS AMONG DIFFERENT MALOCCLUSION GROUPS

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AIM: To evaluate and compare tooth size discrepancies and the effect of hypothetical premolar extractions in skeletal Class I and II, and dental Class I and II malocclusions.
MATERIALS AND METHOD: Tooth size analyses were performed on 56 pre-treatment orthodontic models with a digital calliper, and mesial-distal tooth size ratios were measured as described by Bolton. The models were divided into two groups according to the patient's ANB values [Class I (n = 39) and Class II (n =17)] and then into two subgroups according to the dental relationships [Class I (n = 26) and Class II (n = 30)]. Tooth size discrepancies were calculated for each group and subgroup. Hypothetical premolar extractions were performed in the following combinations: all first premolars; upper first and lower second premolars; upper second and lower first premolars; all second premolars. Bolton's analysis was applied to all final measurements to determine whether a tooth size discrepancy had been created. The results were statistically evaluated.
RESULTS: No statistically significant differences were found between tooth size discrepancies in skeletal Class I and II, dental Class I and II or the hypothetical premolar extraction groups ($P > 0.05$). In skeletal Class I and II and dental Class I and II groups, the overall Bolton ratio was significantly higher than the ratio in all hypothetical premolar extraction groups ($P < 0.001$). For skeletal Class I and II and dental Class I and II groups, the hypothetical removal of all first premolars and upper first and lower second premolars created fewer discrepancies.
CONCLUSIONS: Extractions of all first premolars or upper first and lower second premolars should be the first choice in order to preserve the nearest pre-treatment overall Bolton ratio in all skeletal and dental Class I and II groups.

240 MANDIBULAR GONIAL ANGLE ON PANORAMIC RADIOGRAPHS: COULD IT BE USED IN SKELETAL VERTICAL ASSESSMENT?

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AIM: To investigate the relationships between cephalometric SN-GoMe, ANB and gonial angle determined on panoramic radiographs, and to evaluate the use of panoramic gonial angles in skeletal vertical assessment.

MATERIALS AND METHOD: Pre-treatment cephalometric and panoramic radiographs of 145 orthodontic patients. The radiographs were divided into three groups according to SN-GoMe values [high angle group = 42.14 ± 4.67 degrees (n = 84), normal angle group = 32.78 ± 1.91 degrees (n = 50) and low angle group = 25.68 ± 2.31 degrees (n = 11)]. They were then divided into three subgroups according to ANB values [Class I (n = 66), Class II (n = 61) and Class III (n = 18)]. The gonial angles were formed by tracing a line tangent to the distal border of the ascending ramus and condyle and a line tangent to the lower border of the image of the mandible on each side on the panoramic radiographs. The intersections of these lines were measured as left and right gonial angles. Left and right gonial angles and their arithmetic means were used for statistical evaluations.
RESULTS AND CONCLUSION: No statistically significant differences were found between the left, right and mean gonial angles in all skeletal groups ($P > 0.05$). The left, right and mean gonial angles in the high angle group were significantly higher than in the normal and low angle groups ($P < 0.001$). When SN-GoMe values were compared with left, right and mean gonial angle values, positive correlations were found (r = 0.60, r = 0.61 and r = 0.63, respectively). No statistically significant correlations were found between ANB and the left, right and mean gonial angles. A regression analysis was formulated according to the study results: y(SN-GoMe) = –37+(0.63 × mean gonial angle).

241 EFFECT OF SALIVA AND BLOOD CONTAMINATION ON SHEAR BOND STRENGTH OF METAL BRACKETS

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AIM: To assess the effect of blood and saliva contamination on the shear bond strength (SBS) of four different orthodontic adhesives, Transbond XT primer, Transbond plus self etch primer (SEP), Assure hydrophilic primer, and Smartbond cyanoacrylate adhesive.
MATERIALS AND METHOD: One hundred and twenty bovine permanent mandibular incisors randomly divided into 12 groups; each group containing 10 specimens. Each primer-adhesive combination was tested under different enamel conditions: dry, blood and saliva contamination after priming. Stainless steel maxillary central incisor brackets were bonded to the teeth. Shear forces were applied to the samples using a Zwick universal testing machine. Bond strengths were measured in megapascals.
RESULTS: The SBS in the Smartbond cyanoacrylate adhesive group was significantly lower than all other groups; however it was the only adhesive that was not affected by contamination conditions. Saliva and blood contamination resulted in a significant decease in SBS in the Transbond XT and Assure groups. Transbond plus SEP was also negatively affected by blood contamination even though it was a suitable adhesive for bonding in the presence of saliva contamination.

242 CLINICAL FAILURE RATE OF SELF-LIGATING AND EDGEWISE BRACKETS BONDED WITH CONVENTIONAL ACID-ETCHING AND SELF–ETCHING PRIMER

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AIM: To comparatively assess the failure rate of brackets bonded with a self-etching adhesive and conventional phosphoric acid in patients followed for 12 months of active treatment.
SUBJECTS AND METHOD: Sixty-two patients with complete permanent dentitions, similar treatment planning, and mechanotherapy were selected for the study. GAC Microarch edgewise brackets and Ormco Damon2 brackets were bonded employing a split mouth design, using 3M Transbond Plus Self-Etching Primer (SEP) and conventional acid etching, applied in an alternate sequence so that the adhesives were equally distributed on the maxillary and mandibular right and left quadrants. The patients were followed for 12 months, and the frequency of first time failures recorded was analyzed with a Chi square test and logistic regression modelling (alpha = 0.05).

RESULTS: No difference in failure incidence was noted for either bracket-adhesive and mandibular or maxillary arch combinations, whereas a statistically significant difference was shown for right-side bonded appliances.
CONCLUSIONS: Bonding of self-ligating brackets with SEP does not demonstrate a higher probability for failure relative to standard bonding procedures and conventional brackets.

243 EVALUATION OF CEPHALOMETRIC CHANGES IN SKELETAL CLASS III PATIENTS AFTER ORTHODONTIC-SURGICAL TREATMENT

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AIM: To evaluate the range of acquired skeletal and dental changes following combined treatment.
MATERIALS AND METHOD: Cephalometric radiographs of 12 patients (3 males, 9 females) who had undergone orthodontics and orthognathic surgery, including mandibular setback, maxillary advancement, genioplasty or a combination of these were retrospectively investigated. The cephalograms of each patient were independently traced twice and the means of the measurements before and after treatment were compared by a paired *t*-test.
RESULTS: The most important skeletal change was an increase in ANB from 0.93 ± 3.30 to 3.5 ± 3.29 degrees. Dental changes included an increase in overjet from –0.70 ± 3.91 to 2.41 ± 0.90 mm and also an increase in overbite from –0.87 ± 3.33 to 1.85 ± 0.91 mm. The most significant soft tissue changes included an increase of labio-mental fold depth from 4.29 ± 1.36 to 6.58 ± 1.98, and protrusion of upper lip, after an increase of Ls from 83.50 ± 5.92 to 87.43 ± 5.94.
CONCLUSION: The most important changes were in the horizontal dimension and skeletal base, which are not achievable with only orthodontic treatment. The increase in soft tissue harmony was related to the increase in concavity of the lower lip and dislocation of upper lip forward.

244 CRANIOFACIAL FORM AND FUNCTION OF THE UPPER AIRWAY IN ADULT PATIENTS WITH OBSTRUCTIVE SLEEP APNOEA

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AIM. To determine possible diagnostic obstructive sleep apnoea (OSA) characteristics of the craniofacial complex, as assessed through lateral cephalometric radiography and analysis.
SUBJECTS AND METHOD: Forty male patients (27-64 years of age), diagnosed and treated for OSA. The control sample comprised 44 male patients (20-59 years of age), randomly selected from the files of three private orthodontic practices in Athens. Lateral cephalometric radiographs were taken, under standardized conditions, for all subjects. Cephalometric variables pertaining to the hard and soft craniofacial tissues were determined and compared between the two groups, and the statistical significance of their difference was assessed.
RESULTS. The mean craniofacial morphology of patients with OSA was characterized by a readjustment of the position, the size, and the function, of major morphogenetic fields (of the hard and soft tissues) of the craniofacial complex. The most important finding related to the angle between the anterior cranial base (nasion to sella) and the plane of the spine (C4 to C2), which was greater in the OSA group. Recorded craniofacial deviations in the OSA patients were correlated to an overall decrease of the pharyngeal dimensions.
CONCLUSION: These findings support the interrelationship between craniofacial form and function of the upper airway. An overall backward extension of the head, constituting an adaptive change in head posture, seems to accommodate the function of breathing in apnoeic patients, thereby facilitating the viability of the individuals.

245 EXPRESSION OF PERIODONTAL LIGAMENT CELL-ENRICHED AND

ODONTOBLAST-ENRICHED PROTEINS IN EXPERIMENTAL TOOTH MOVEMENT

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AIM: To investigate the expression of periodontal ligament (PDL) 22 and odontoblast (OD) 314 in experimental tooth movement. In a previous study, these two proteins have been reported as being unrelated to a specific cell.
MATERIALS AND METHOD: Twenty rats had springs applied between the maxillary molars and incisor. After 14 days, all rats were killed and histological samples were stain with haematoxylin-eosin stain, immunohistochemistry stain.
RESULTS: PDL 22 was not expressed in the alveolar bone, cementum or its osteocyte and cementocyte. It was weakly expressed in the PDL cells. Osteoblasts, cementoblasts in newly formed cementum, and alveolar bone expressed PDL 22 and more strongly expressed it in pre-cementum, osteoid. OD 314 was not expressed in alveolar bone, cementum, PDL and its osteocyte and cementocyte. Strong expression of OD 314 was detected in the osteoblasts, cementoblasts and in newly formed cementum and alveolar bone. Osteoid, pre-cementum's blast cell expression pattern was stronger than newly formed cementum and alveolar bone.
CONCLUSION: PDL 22 and OD 314 play an important role in differentiation of cementoblast and osteoblast during orthodontic tooth movement.

246 EFFECT OF SALIVA CONTAMINATION ON SHEAR BOND STRENGTH OF ORTHODONTIC BRACKETS BONDED WITH SELF-ETCHING PRIMERS

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AIM: To evaluate the influence of saliva contamination on shear bond strength (SBS) and location of adhesive failure using two different self-etching-primers (Transbond Plus and i-Bond) compared with a conventional acid-etch method (37 per cent phosphoric acid and Transbond XT) for bonding of orthodontic brackets.
MATERIALS AND METHOD: A total of 150 extracted human premolars were randomly allocated to six different groups (n = 25). Teeth with damaged surfaces were excluded. The teeth were cleaned with fluoride- and oil-free pumice. Orthodontic metal brackets (APC II, Victory Twins 22UNIV, 3M Unitek) were used (surface area = 13.96 mm^2). Each precoated bracket was bonded using the same force. For contamination, a saliva replacement (Ptyalin) was used. After contamination the surface was air-dried for 5 seconds and the bonding procedure was continued. The bonded teeth were stored in deionized water at 37°C for 30 days and thermocycled for 24 hours before debonding with a universal testing machine (quickTest) with a crosshead speed of 0.5 mm/minute. The load was recorded at bond failure. The location of adhesive failure was determined microscopically under ×10 magnification using the Adhesive Remnant Index (ARI). Statistical analyses were conducted using ANOVA ($\alpha = 0.05$), *post hoc* Tukey's test and Weibull analysis.
RESULTS: Transbond Plus showed a significantly lower mean SBS without saliva contamination. With Transbond XT contamination decreased the SBS. There was no significant difference in the ARI score among the groups (Kruskal-Wallis test, $P > 0.05$).
CONCLUSION: Clinically acceptable bond strengths could be found in all adhesive used in this study. Self-etching-primers displayed a lower influence of saliva contamination. The SBS of Transbond Plus was significantly increased by saliva contamination, confirming its moisture tolerance.

247 REMINERALISATION POTENTIAL OF FLUORIDE MOUTHRINSES ON ERODED ENAMEL MEASURED BY QUANTITATIVE LIGHT-INDUCED FLUORESCENCE

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AIM: An *in vitro* investigation using pre-eroded bovine enamel to test remineralisation after

treatment with three commercially available fluoride containing mouthwash preparations.
MATERIALS AND METHOD: The crowns of 40 bovine incisors varnished completely except for a 3 × 5 mm buccal window were pre-eroded with orange juice, pH 3.85. Four groups of 10 teeth were dipped for 27 days in one of four solutions: artificial saliva pH 6.75 (AS), 0.05 per cent sodium fluoride with alcohol base pH 5.98 (FAB), 0.05 per cent sodium fluoride alcohol free pH 5.95 (FAF), 0.2 per cent sodium fluoride ph 6.04(F). Every 3-4 days (8 times) a quantitative light induced (QLF) image was made to measure the mineral Q. Data were tested for normality with ΔF content of each enamel window measuring normal Q-Q plots and Kolmogorov-Smirnov test with parametric one-way ANOVA for hypothesis testing. Q showed remineralisation of all ΔQ.
RESULTS: The mean percentage change in samples was: AS 5.6 per cent; FAB 27.9 per cent; FAF 45.4 per cent; F 39.9 per cent. QLF defined incremental timepoint mineral change as in Pretty *et al*. (2003). FAF ($P < 0.05$) was most effective at producing remineralisation. FAF additives sodium phosphate and disodium phosphate are aqueous soluble and alcohol insoluble.

Pretty I A, Pender N, Edgar W M, Higham S M 2003 The *in vitro* detection of early enamel de- and re-mineralization adjacent to bonded orthodontic cleats using quantitative light-induced fluorescence. European Journal of Orthodontics 25: 217-223

248 CHOICE OF FUNCTIONAL APPLIANCE THERAPY – IS THERE ANY DIFFERENCE IN TREATMENT OUTCOME?

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AIM: To compare changes during treatment and follow-up of skeletal Class II malocclusion subjects treated with either a removable or a fixed functional appliance.
MATERIALS AND METHOD: A series of lateral cephalograms obtained from a group of consecutive male patients treated with headgear-activator [removable functional appliance (RFA) group] for 12 months was compared with a matched group treated with a Herbst appliance for 6 months, followed by 'retention' with an Andresen Activator for six months [fixed functional appliance (FFA) group]. The patients were then followed for a further 24 months. Lateral cephalograms were obtained at start of treatment (T0) and after 6 (T6) and 12 (T12) months of treatment, and after another 24 months (T36). Interpolations were made to obtain data representing exactly the same length of observations periods.
RESULTS: There were significantly more pronounced changes with the FFA than with the RFA during the initial 6 months of treatment (T0-T6). After 36 months (T0-T36) of treatment and observation, the maxilla tended to become retruded ($P = 0.052$) in the RFA group, whereas there was no significant change in maxillary prognathism in the FFA group, the difference between the two groups being statistically significant ($P < 0.05$). On the other hand the increase of mandibular prognathism in the former group was only marginally statistically significant ($P = 0.052$) and highly significant in the later group ($P < 0.001$).
CONCLUSIONS: Treatment with removable and fixed orthodontic devices not only modifies growth in the short-term, but also seem to have the potential to cause permanent changes in the prognathism of both jaws.

249 FRONTAL CEPHALOMETRIC ANALYSIS IN UNILATERAL POSTERIOR CROSSBITE SUBJECTS

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AIM: To evaluate the influence of unilateral crossbite in the development of craniofacial asymmetries, by comparing the frontal cephalometry of patients with unilateral posterior crossbite and subjects without any crossbite, and to establish whether or not a dental crossbite always develops on the same side of the skeletal asymmetry.

SUBJECTS AND METHOD: One hundred and two subjects with unilateral posterior crossbite, 58 females and 44 males (mean age 10.4 ± 2.3 years) were compared with a control group of 250 subjects, 116 females and 94 males (mean age 10.6 ± 2.1 years). Each patient and subject underwent postero-anterior teleradiography and a frontal cephalometric evaluation was performed.
RESULTS: Patients with unilateral posterior crossbite were more frequently affected by craniofacial asymmetries compared with subjects without a crossbite. The crossbite side corresponded to the side of the skeletal asymmetry only in 44 per cent of the subjects.
CONCLUSION: Skeletal asymmetry in crossbite patients is very complex and the axis of the examined skeletal region is characterized by a displacement parallel to the reference axis.

250 HEMIFACIAL MICROSOMIA AND DENTAL MATURITY

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AIM: To examine the relationship between hemifacial microsomia (HFM) severity and dental maturation.
MATERIALS AND METHOD: Computer tomograms (CTs) and dental pantomograms (DPTs) of 45 children (28 boys, 17 girls, mean age 9.6 years) with HFM type IIb and type III (according to Kabans classification) were available. The interpretation of measurements on the CTs was based on horizontal slices and two as well as three-dimensional reconstruction. Horizontal and vertical dimensions of the mandible and maxilla were measured. Dental maturity was evaluated on DPTs using the method of Demirijan. The dimensions and stages of dental maturity on both sides were compared. The results were statistically analysed.
RESULTS: In type IIb and III HFM, the mean vertical dimension on the affected side of the maxilla (orbital rim to alveolar ridge) was 10.2 mm shorter than on the opposite side. The mean maxillary length (condylion-point A) was 3.1 mm longer on the affected side. The mean length of the mandible (condylion–gnathion) on the affected side was shorter (–27.1 mm) than on the unaffected side. The height of the mandibular corpus (mandibular cant) to alveolar ridge was insignificantly shorter on the affected side in the region of the first lower permanent molar. In 67.8 per cent of patients there was symmetry of dental maturation on both sides. Of those subjects showing asymmetric tooth maturation, 56.5 per cent had more advanced dental development (significant for lower second molar and canine) and 43.5 per cent retarded dental maturation on the affected side.
CONCLUSIONS: The most severe degree of underdevelopment in HFM has no significant influence on dental maturation on the affected side, although advanced as well as retarded maturation was observed.

251 PHOTOGRAMMETRIC ANALYSIS OF SOFT TISSUE CHANGES RELATED TO INCISOR POSITION CHANGES FOLLOWING ADULT TREATMENT

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AIM: To analyze soft tissue changes related to incisor position changes following treatment in adult patients.
SUBJECTS AND METHOD: Twenty-one adult patients (4 males, 17 females), mean age 25.9 years, treated with the segmented arch technique, divided in to Class 2 division 1 and Class II division 2, according to upper incisor position. The latter was evaluated on lateral cephalograms through incisor inclination on SNA-SNP, incisor inclination on NA and overjet. In 10 patients the upper incisor had a buccal inclination (group A), and in 11 a palatal inclination (group B). Standardized photographs in natural head position before and after treatment were traced and several soft tissue parameters were digitally measured by the same orthodontist. Data were analyzed by paired *t*-test.
RESULTS: No changes in lower face height occurred during treatment. In group A, the upper lip was significantly retracted with a mean movement of 2 mm and upper lip length increased. Smaller

changes occurred in the lower lip. The interlabial gap significantly decreased in group A. No significant soft tissue changes could be detected in group B.
CONCLUSIONS: Orthodontic correction of upper incisor protrusion in adults seems to positively affect soft tissue aesthetics, while the buccal inclination of palatally inclined upper incisors has little effect on lip position.

252 ELECTROMYOGRAPHIC EFFECTS OF DIFFERENT CONDYLAR POSITIONS
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AIM: To investigate the muscular effects of different condylar positions.
SUBJECTS AND METHOD: Fourteen consecutive patients (mean age 22.9 years) seeking orthodontic treatment were submitted to a preliminary phase of occlusal stabilization with a centric relation (CR) splint obtained with the Roth 'power centric' technique. Electromyographic (EMG) recordings were obtained from the left and right masseter and temporalis anterior muscles with (CR) and without (intercuspal position, MI). Occlusal control of the splint and the EMG evaluations were performed by two independent operators. EMG recordings were compared and amplitude values and specific indexes were considered.
RESULTS: CR position was compatible with good muscular function, as demonstrated by the physiological range of the EMG parameters during evaluation. Good correspondence between the clinical and instrumental evaluation was observed: a control protocol of the splints seems to ensure functional equilibrium, independently from the EMG.

253 CONTROL OF ORTHODONTIC PAIN CAUSED BY FIXED APPLIANCES
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AIM: The control of pain during orthodontic treatment is of interest to both clinicians and patients. There has been limited research into the control of this pain and there is no standard regimen for controlling this discomfort. The aim of this prospective study was to determine the pain sequelae in fixed orthodontic treatment and to comparatively evaluate the analgesic effects of both pre- and post-operatively administered non-steroidal anti-inflammatory drugs.
SUBJECTS AND METHOD: One hundred and fifty adolescent orthodontic patients who were to undergo bonding of teeth in at least one arch. The patients were randomly assigned to 1 of 6 groups: (1) placebo/placebo, (2) ibuprofen/ibuprofen, (3) flurbiprofen/flurbiprofen (4) paracetamol/paracetamol (5) naproxen sodium/naproxen sodium (6) aspirin/aspirin. Pain evaluation was made during chewing, biting, fitting of anterior and posterior appliances, using a 100 mm visual analogue scale (VAS) for 7 days. Evaluations were made on questionnaires completed by the patients, and the pain characteristics during orthodontic treatment were determined.
RESULTS: All of the analgesics succeeded in decreasing the pain levels compared with the placebo group at most time intervals. However, the naproxen sodium and aspirin groups showed the lowest pain values and paracetamol group showed similar VAS results to these two analgesics.
CONCLUSION: Although both pre- and post-operative administration of naproxen sodium and aspirin showed the lowest pain values, considering the side-effects, paracetamol should be the analgesic of choice in orthodontic patients.

254 EFFECTS OF A CHLORHEXIDINE VARNISH ON SHEAR BOND STRENGTH IN INDIRECT BONDING PROCEDURES
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AIM: To evaluate the effects of an antimicrobial varnish on the shear bond strength (SBS) of the brackets/adhesive failure mode of metallic orthodontic brackets bonded with an indirect bonding resin

and compare it with an indirect bonding control group and a direct bonding group with a hydrophilic primer/Cervitec varnish mixture.
MATERIALS AND METHOD: Sixty non-carious human premolars were divided into three groups. Group 1 was an indirect bonding control group and following preparation of indirect bonding trays and acid etching of the enamel, the brackets were bonded to teeth using Sondhi Rapid Set. In Group 2, prior to bonding, Cervitec varnish was painted on the etched enamel. Indirect bonding was then carried out as in group 1. In Group 3, Transbond MIP primer and Cervitec varnish were thoroughly mixed in a 1:2 proportion, applied to the enamel surface, light cured for 20 seconds, and then the brackets were bonded. The SBS values of these brackets were recorded and the Adhesive Remnant Index scores determined. Data were analyzed using analysis of variance (ANOVA), Tukey HSD, and Chi-square tests.
RESULTS: ANOVA revealed statistically significant differences in SBS among the various groups tested ($P < 0.05$). Indirect bonding of brackets with Sondhi Rapid Set following the application of Cervitec varnish showed a significantly lower SBS when compared with the direct bonding/Cervitec and the indirect bonding group.
CONCLUSION: Cervitec varnish decreases the adhesion of brackets bonded indirectly. However, further studies with different application methods are needed.

255 TRUE HORIZONTAL AND FRANKFORT HORIZONTAL FOR CEPHALOMETRIC ANALYSIS

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AIM: To investigate the relationship of Frankfort horizontal (FH), drawn through soft (FH1) and hard (FH2) tissue landmarks, Frankfort Horizontal (FH2) and true horizontal (TH), TH and anterior cranial base.
MATERIALS AND METHOD: The lateral cephalometric radiographs and facial photographs of 45 patients aged 9-15 years. Cephalograms were obtained with the head orientated in FH (tragus-orbitale) and facial photographs in natural head position (NHP). FH2 (porion-orbitale) was used for cephalometric analysis. On all photographs soft tissue pronasale (Pr') and pogonion (Pg') were traced, and the angle between Pr'-Pg' and TH calculated. The same angle was constructed on cephalometric radiographs. The angles between TH and FH2 and TH and NS were then measured. The difference between true vertical-FH1 and true vertical-FH2 represented the angle between the two Frankfort horizontals.
RESULTS: The two FH were never coincident in all subjects; a mean angle of 12.7 ± 5.33 degrees was found. Tragus was always lower than porion. A mean angle of 5.03 ± 3.79 degrees was found between FH obtained through hard landmarks and TH. The mean angle between TH and anterior cranial base was 9.1 ± 4.02 degrees.
CONCLUSION: Lateral cephalometric radiographs recorded in NHP are more clinically relevant.

256 FACEMASK TREATMENT FOLLOWED BY FIXED APPLIANCES IN CLASS III ADOLESCENT PATIENTS

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AIM: Forty per cent of Class III malocclusions are the result of a deficient maxilla. The treatment plan of choice would be to protract the maxilla. It is widely accepted that maxillary protraction be initiated before 8 years of age to produce more skeletal changes and less dental movement. Adolescents can be treated with a combination of surgical and orthodontic therapy. The purpose of this study was to evaluate the effects of facemask protraction in adolescent patients.
MATERIALS AND METHOD: Pre-treatment (T1), treatment with a facemask (T2) and post-treatment (T3) lateral radiographs of 24 adolescent patients with a Class III malocclusion treated with

a facemask followed by fixed appliances.
RESULTS: Treatment results at T2 showed proclination of the upper incisors (2.44 ± 1.08 mm), an increase in SNA (1.75 ± 0.15 degrees), forward movement of point A (1.42 ± 0.58 mm), mesial tipping (2.75 ± 0.16 mm) and movement (2.54 ± 0.43 mm) of the first molars and a decrease the nasolabial angle (2.39 ± 0.88 degrees). At T3 there was proclination of the upper incisors (3.67 ± 1.94 mm), an increase in SNA (2.44 ± 0.10 degrees), a decrease in SNB (1.44 ± 1.07 degrees), mesial tipping (4.19 ± 0.1 mm) and movement (2.98 ± 0.47 mm) of the first molars, clockwise rotation of the mandible (2.06 ± 0.31), an increase in ANB (2.02 ± 0.54 degrees) and Wits (2.15 ± 0.45 mm), upper lip protrusion (1.16 ± 0.09 mm) and lower lip retrusion (0.77 ± 0.5 mm), and an increase profile convexity (2.9 ± 1.19).
CONCLUSION: Facemask treatment followed by fixed appliances should be considered as an alternative to orthognathic surgery in the treatment of adolescents with Class III malocclusions characterized by maxillary retrognathism.

257 CORRELATION BETWEEN MORPHOLOGY OF THE FIRST AND SECOND CERVICAL VERTEBRA, HEAD POSTURE AND MANDIBULAR GROWTH DIRECTION

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AIM: To determine the correlation between the morphology of the first and second cervical vertebra, head posture and mandibular growth direction.
MATERIALS AND METHOD: The lateral cephalometric radiographs of 200 patients aged 10-15 years, of both genders with normal occlusion and a skeletal Class I relationship. On each radiograph, recorded in natural head position, five variables for cervicovertebral anatomy, five variables for head posture and seven linear and angular mandibular variables were measured.
RESULTS: There was a significant negative correlation between the height of the atlas dorsal arch and craniovertical, craniocervical angle and mandibular growth direction, so children with a low dorsal arch have backward mandibular rotation and more extended head posture. In addition, the heights of the anterior atlas arch, the axis dorsal arch and odontoid processes were negatively correlated with mandibular growth direction.
CONCLUSION: Cervicovertebral anatomy, especially the atlas dorsal arch, may have a diagnostic value for head posture and mandibular growth direction.

258 IMMUNOHISTOCHEMICAL STUDY OF THE HUMAN PERIODONTAL LIGAMENT DURING ORTHODONTIC TOOTH MOVEMENT

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AIM: To investigate modifications induced by the application of a precalibrated and constant orthodontic force on human periodontal ligament (PDL) fibronectin, type I and IV collagen.
MATERIALS AND METHOD: A Ni-Ti coil-spring was applied to the maxillary and mandibular premolars. The teeth were subsequently extracted for orthodontic reasons 3-72 hours, 7, 14 and 28 days after force application. The samples were obtained by scratching the radicular surface both at the pressure and tension side. The results were compared with those related to homologous opposite side teeth not submitted to force. PDL specimens were scanned with immunofluorescence technique using anti-Fibronectin, anti-collagen type I and IV antibodies. Observations were carried out using a confocal microscope, CLSM 510 Zeiss model.
RESULTS: Type I collagen showed an increase on the pressure side until day 14. At day 28, there was a consistent reduction of fluorescence signal. Type IV collagen showed, at all times, a reduction at both the pressure and tension sides compared with the controls. Likewise, type I collagen and fibronectin showed an increase on the pressure side until 72 hours; at 28 days there was a reduction. On the tension side fibronectin showed a decrease at all times periods. Collagen and fibronectin

increased mainly on the pressure side, which could be a consequence of an increase in PDL metabolism induced by force application.
CONCLUSION: There is a characteristic change in PDL protein content following orthodontic force application.

259 TORQUE PLAY BETWEEN LOW FRICTION 0.022-INCH SLOT BRACKETS AND STAINLESS STEEL WIRES OF DIFFERENT SIZES

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AIM: To determine the 'torque play' in 0.022 inch brackets using different sizes of stainless steel archwires.
MATERIALS AND METHOD: Four bonded brackets were investigated on upper incisor and premolar (Kilgore) dental models: MBT (3M Company), Smart Clip (3M Company), Damon III (Ormco) and Synergy SWLF (Rocky Mountain Orthodontic Company). An experimental model was designed to study the torque play of these brackets using different stainless steel wires (0.017 × 0.025 inch and 0.019 × 0.025 inch). Evaluation of the deviation angle was determined using digital photographs and a computer program.
RESULTS: In general, the values of torque play obtained varied between 13 degrees with a 0.019 × 0.025 inch wire and 20 degrees with a 0.017 × 0.025 inch wire.
CONCLUSIONS: Variations in bracket torque between 10 and 20 degrees do not have clinical implications.

260 SUITABILITY OF THE UPPER ARCH FOR ORTHODONTIC MICRO-IMPLANTS

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AIM: Stability of orthodontic micro-implants depends on the amount and quality of bone at the implant site, and on a sufficient distance from important structures such as dental roots or the maxillary sinus. The aim of this study was to assess the suitability of the upper arch for the placement of orthodontic implants.
MATERIALS AND METHOD: Dental computed tomographs (Somaton Plus 4, Siemens, Germany) of 51 adult patients who underwent examination before osteotomy of displaced third molars (average age 24.0 ± 8.1 years, 27 male, 24 female). The total amount of bone was measured in the maxillary alveolar process and adjacent structures, including the tuber maxillae, the hard palate, the nasal spine and the zygomatic process.
RESULTS: The amount of bone in the alveolar process showed large variations especially in the molar region. Sufficient bone, allowing placement of orthodontic micro-implants, could be found in the retromolar region and adjacent to the anterior nasal spine. The height of the anterior hard palate was 9.5 ± 2.1 mm. In the zygomatic process and the zygoma, sufficient bone for implants of more than 10 mm length was observed.
CONCLUSION: Due to the extension of the maxillary sinus, the amount of bone in the alveolar process of the upper arch is limited. Generally, sufficient bone can be found in the anterior nasal spine area, the tuber and the anterior part of the hard palate. Considering the variable extension of the maxillary sinus, a precise radiographic examination of the operation site should precede surgery to avoid complications.

261 ON-SCREEN SUPERIMPOSITION OF CEPHALOMETRIC RADIOGRAPHS

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AIM: To develop a method for on-screen superimposition of lateral cephalometric radiographs

using stable structures identified on digital images.
MATERIALS AND METHOD: Digital lateral cephalometric radiographs taken in a standardized head posture were used to develop a method of superimposition with the aid of Viewbox 3.1.1.6® software for Windows®. This program was modified to allow serial cephalometric images of the patient to appear on the same screen. These images could then be moved with the curser, one over the other, so stable structures previously defined in the cranial base, maxilla and mandible could be used to reveal changes. The digital cephalometric images of the anterior border of sella and anterior cranial base (Melsen, 1974) were used for initial superimposition to show overall differences. Maxillary changes were demonstrated using the anterior outline of the zygomatic buttress and anterior palate shape, while mandibular changes were highlighted using the internal cortical outline of the symphysis image plus the cortical outline of the mandibular canal (Björk, 1977). Three registration lines were created, one for cranial base, one for the maxilla and one for the mandible, to assist subsequent superimposition. A duplicate determination (n = 20) using a profile analysis (Sarnäs and Solow, 1980) was then carried out to determine the method error for digital point placement, as a basis for a further study of treatment changes in patients with an increased overjet.
RESULTS: Duplicate determinations for the profile analysis demonstrated a mean method error for on-screen digitization of 0.74 degrees for angular measurements and 0.41 mm for linear dimensions, with no significant differences between the first and second sets of recordings.
CONCLUSIONS: On-screen superimposition of serial digital images is now possible using modified the Viewbox® software, and provides a useful reproducible method to study changes taking place during growth and treatment.

262 THE GENETIC FUNCTIONAL MATRIX THEORY
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AIM: The human genome project demonstrated genomic controls of all developmental processes, at cellular, structural and organ levels. Microarray technology has been applied to decipher the signals that trigger and control specific molecular events of *in vitro* differentiation of cartilage and bone. Cartilage plays a critical role in condylar growth because it is the template onto which bone forms. The objectives of the current study were 1. To screen, using microarray analysis, for the expression profile of genes related to chondrogenesis in the condyle; 2. To identify genes related to the 'mechanotransduction theory' that are expressed in condylar cartilage; 3. To correlate such genes to genes that regulate condylar cartilage formation.
MATERIALS AND METHOD: Two hundred and eighty rats were divided into seven experimental (advancement) and seven control groups. The rats were sacrificed at different time points and total RNA was extracted for microarray analysis and RT-PCR. 'Gene spring software' was used in the analysis of microarray results and the search was limited to genes that showed a 2-fold or more change between groups.
RESULTS: Of 624 genes, only 25 were related to different aspects of cartilage development. Fifteen genes were up-regulated while 10 were down-regulated. Several genes were identified for the first time in the condyles and were cell-cell attachment genes (CHAD), cell-matrix attachment genes (C-CAM4), cellular movement genes (myosin).
CONCLUSIONS: Transmission of extra-skeletal stimuli to cells in condylar cartilage through mechanotransduction leads to expression of several genes that directly impact on condylar growth. This demonstrates an orchestrated interplay between mechanotransduction and genetic regulation.

263 CHRONOLOGICAL AGE, CERVICAL VERTEBRAE AND HAND-WRIST SKELETAL MATURATION – IS THERE A RELATIONSHIP?
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AIM: To i) investigate the relationship between chronological age and maturation of cervical vertebrae, ii) identify the relationship between chronological age and maturation stage evaluated on hand-wrist radiographs, and iii) determine whether maturation of the cervical vertebrae will correlate with the maturation indicated by hand-wrist radiographs in a Turkish population.
MATERIALS AND METHOD: Lateral cephalometric and hand-wrist radiographs of 503 subjects (213 males, 290 females). The subjects ranged in age from 5 years 3 months to 24 years 1 month, with a mean age of 12.02 ± 3.00 years (12.00 ± 2.07 years for males and 12.03 ± 3.03 years for females). Cervical vertebral development was evaluated using the Hassel and Farman modification of Lamparski's criteria. Skeletal maturation stage of each hand-wrist radiograph was determined according to the method described by Björk and Grave and Brown, and dental age using Demirjian method.
RESULTS: In children of Turkish origin, the cervical vertebrae method may be used as a maturity indicator of the pubertal growth spurt with a degree of confidence similar to some of the other indicators described in the use of the hand-wrist radiograph.

264 A LOW FRICTION TECHNIQUE USING STRAIGHTWIRE FIXED APPLIANCES

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AIM: To show the selection of archwires and biomechanics in different dental and skeletal malocclusion subjects treated with the straightwire low friction (SWLF) technique.
SUBJECTS AND METHOD: Twenty-five patients with a maxillary/mandibular arch length discrepancy (above –10 mm) treated without extractions. New therapeutic protocols for the SWLF technique were developed, with the Rocky Mountain Company, Denver, Colorado, USA. The protocols included: 1. Functional occlusal evaluation with the Gothic Arch; 2. Development of new superelastic (Thermal NiTi) and Beta-Titanium (Beta III Titanium) wires; 3. New bracket prescription (Synergy–SWLF); 4. Low friction ligatures; 5. Crimpable hooks; 6. New modules and elastics; 7. Orthodontic stripping; 8. Microscrews for alveolar bone anchorage. The variables evaluated at the end of treatment were: static and dynamic occlusion, arch form and their changes, smile and facial aesthetics, treatment plan, timing and treatment sequence.
RESULTS: Favourable outcomes were achieved in all subjects with improvement of the aesthetic and functional parameters. Ideal static (Andrews keys) and dynamic occlusion (Gothic Arch) were achieved in 14 patients, and a good occlusion in 11. Seven archwires per patient (4 maxillary and 3 mandibular) during, on average, a treatment period of 17 months (SD: 4) were used. The number of appointments was nine (SD: 3).
CONCLUSION: A combination of new superelastic wires and low friction brackets and ligatures (SWLF) produces light and constant forces during orthodontic treatment.

265 FREQUENCY AND CONSISTENCY OF ORTHODONTIC EXTRACTION DECISIONS BETWEEN EXAMINERS WITH DIFFERENT CLINICAL EXPERIENCE

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AIM: To investigate the effects of different clinical experience on the decision to extract teeth for orthodontic reasons.
MATERIALS AND METHOD: Complete orthodontic digital records obtained from 84 patients with different types of malocclusions were shown to 12 orthodontists, who had to decide whether or not to extract teeth, and to indicate which teeth they would extract. Each orthodontist performed the treatment plan independently. The orthodontists were divided into four groups according to their clinical experience. Agreement between examiners was calculated using kappa statistics.
RESULTS: Orthodontic decisions to extract were made in approximately 30 per cent of the patients. The extraction of four premolars was the most common decision (20.7 per cent), followed by two

premolars (6.9 per cent). The least frequent decision was that of one lower incisor (1.2 per cent). The frequency of extraction decisions did not differ significantly ($P > 0.05$) among the four groups of orthodontists. Kappa values ranged from 0.35 to 0.59, showing poor to moderate agreement between orthodontists, but were not influenced by the length of clinical experience.
CONCLUSION: The frequency and the consistency of orthodontic extraction decisions are not influenced by orthodontic experience.

266 POST-TREATMENT CHANGE OF OVERBITE AS RELATED TO INCISOR INCLINATION AND POSITION

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AIM: To investigate post-treatment overbite relapse as related to incisor inclination and interocclusal position changes (Backlund's index, 1958), and furthermore, to identify cephalometric variables for prediction of post-treatment overbite relapse. The null hypothesis is that post-treatment interincisal relationship, inclination and interocclusal position are not related to post-treatment overbite relapse.
MATERIALS AND METHOD: Study models and cephalograms from 97 orthodontically treated patients were analysed with regard to: incisor inclination; interocclusal position on the palatal surface of the upper incisors (Backlund's index) and vertical skeletal relationship before treatment (T1), at retention (T2) and at post-retention at age of 19 years (T3).
RESULTS: There was a significant overbite change at T3 compared with T2 ($P < 0.001$). No correlations could be found between overbite relapse at T3 and incisor inclination, interincisal angle, interocclusal position, or with any other variables at T2. At T1, none of the included variables except ML/NSL and interocclusal position 4 (Backlund´s index) could predict overbite relapse at T3 ($P < 0.05$).
CONCLUSIONS: Orthodontic treatment outcome, as far as interincisal relationship, incisor inclination and interocclusal position are concerned, is not related to long-term overbite relapse. Dentitions characterized by an initial low mandibular plane angle and a gingivally located lower anterior occlusal position (Backlund´s index 4) are prone to overbite relapse.

267 A PROBLEM-BASED LEARNING METHOD IN THE ORTHODONTIC EDUCATION OF STUDENTS

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AIM: After dental education only a few students have sufficient practical experience in patient treatment. Problem-based learning (PBL) is an increasingly common pedagogical method in health sciences education. Many health science educators in other disciplines have begun to use PBL. There is far less information available about the extent and the scope of PBL in dental education. This report describes a case-based, student-centred instructional model designed for orthodontic problem-solving and decision-making in dental general practice.
SUBJECTS AND METHOD: Students in the 4th year of dental school were divided into four subgroups of approximately 10 students. Two tutorial classes used PBL and two a traditional method of seminars. They met in a series of two-hour seminars during the semester. One week prior to each seminar, a paper case was distributed to every student and instructor for advance preparation in the PBL groups and set of learning goals is distributed to every student at the remaining traditional didactic groups. The cases include a clinical situation to demonstrate treatment need to the students. The tutors of the PBL groups received advanced targeted training. At the end of the semester an unannounced test was undertaken by all groups to test their knowledge.
RESULTS: The PBL students group were exposed to more stress but showed an improved understanding of the connections in orthodontic treatment. They also showed a higher interest in the orthodontic topic.

268 A BIOMECHANICAL STUDY OF THE POSITION OF THE CENTRE OF RESISTANCE OF THE ANTERIOR TEETH

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AIM: The position of the centre of resistance (CR) is an essential parameter for the planning of orthodontic tooth movement. To the present, biomechanical studies to determine the position of the CR have concentrated on single teeth. In this study, the load/deflection behaviour of the upper incisors was investigated using finite element (FE) methods in order to evaluate the CR.
MATERIAL AND METHOD: FE models of the four upper incisors and the surrounding structures, periodontal ligament, and alveolar bone were generated based on a three-dimensional data set of a completely dentate maxilla (Viewpoint Data-Labs®). Particular emphasis was placed on the anatomically correct reconstruction of the morphology of the roots and the supporting ligament. The anterior teeth were stabilized with a rigid steel wire with a dimension of 0.46 × 0.64 mm². The 10-noded tetrahedron element of the FE-package, Marc/Mentat®, was used for the analysis. Material parameters of tooth, PDL and bone were taken from previous experimental and numerical studies (tooth: E = 20 GPa, bone: E = 2 GPa, PDL: bilinear elastic, E1 = 0.05 MPa, E2 = 0.22 MPa, εg = 7.5 per cent). To determine the CR, the anterior teeth were loaded with couples of forces of 10 Nmm each via the lateral incisor brackets. The bone was held stationary. The CR was determined as the point of the tooth roots with minimum deflection.
RESULTS: The simulations could not deliver a common axis of rotation for all four anterior teeth, i.e. there was no common CR for the incisors. The position of the CR for the individual teeth was determined to be at 9 and 12 mm apical and 5 mm distal to the point of force application for the lateral and the central incisors, respectively.
CONCLUSIONS: The CR of the anterior teeth was determined to be more apical than reported in previous studies. This is in accordance with earlier clinical and experimental analyses.

269 SAGITTAL AND VERTICAL MAXILLO-MANDIBULAR RELATIONSHIPS IN OPEN BITE SUBJECTS

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AIM: To evaluate the distribution of sagittal relationships among open bite subjects and to clarify the ratio of maxillary retrusion.
MATERIALS AND METHOD: Cephalometric and hand-wrist radiographs of 257 open bite subjects first classified according to their ANB angle as: Class I (ANB = 0-40), Class II (ANB > 40) and Class III (ANB < 00). The groups were then classified according to their maxillary positions: maxillary retrusion, normally positioned maxilla, and maxillary retrusion. Using the GoGN-SN angle, the number of hypo-, normo- and hyper-divergent subjects were determined for each ANB and SNA group. The subjects were also grouped according to their hand-wrist radiographs, as pre-pubertal, pubertal, post-pubertal and adult.
RESULTS: Fifty per cent of open bite cases were Class I, 24 per cent Class II and 26 per cent Class III. Maxillary retrusion was 68 per cent in Class I subjects, 57 per cent in Class II and 75 per cent in Class III. Seventy-two per cent of Class I and 84 per cent of Class II, but only 35 per cent of Class III subjects were hyperdivergent. There were a similar number of subjects in the pre-pubertal (24 per cent) and adult (25 per cent) stages, whereas the distribution was 18 per cent in the pubertal and 31 per cent in the post-pubertal stages.
CONCLUSION: Open bite subjects generally had a Class I sagittal relationship with maxillary retrusion. The Class II group displayed a hyperdivergent morphology, whereas the Class III subjects were mostly normodivergent. In addition maxillary retrusion ratios were high in all of the open bite subjects.

270 WEAR OF PLASTIC BRACKETS

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AIM: Clinical use of plastic brackets has shown that they are in part prone to substantial wear. The purpose of this study was to compare the wear resistance of four commercially available plastic brackets with each other.
MATERIALS AND METHOD: Ten brackets each of (1) pure polycarbonate, (2) ceramic reinforced polycarbonate, (3) fibreglass reinforced polycarbonate, and (4) polyurethane were exposed to wear, following an ageing process according to ISO 10477. The wear was carried out in a brushing device with 140 strokes a minute for three hours. Before and after the wear process the brackets were measured optically (GF Messtechnik GmbH Teltow).
RESULTS: The pure polyurethane brackets showed the least wear resistance of the plastic brackets. The abrasive wear loss averaged 23 per cent for these brackets. No significant difference was observed between polycarbonate, fibreglass reinforced or ceramic reinforced brackets. The wear loss was on average not greater than 5 per cent in these brackets.
CONCLUSIONS: For clinical application the polycarbonate brackets can be recommended. However, the addition of fibreglass and ceramic to the polycarbonate brackets showed no advantages with regard to wear loss.

271 COMPARISON OF MOMENT TO FORCE RATIO OF DIFFERENT SEGMENTED CLOSING LOOPS: A FINITE ELEMENT ANALYSIS

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AIM: To investigate the mechanical characteristics of the Opus loop with regard to the constancy of the moment to force (M/F) ratio compared with three different closing loops [T, L and closed vertical helical loop (VHL)].
MATERIALS AND METHOD: All loops were simulated three-dimensionally in an ANSYS software system with the loop in the same direction (10 × 10 mm). After definition of boundary conditions the loops were loaded. The mechanical characteristics of each loop were analysed in terms of M/F on alpha and beta positions with and without pre-activation bends.
RESULTS: VHL showed lowest anterior and posterior M/F ratio after 1 mm activation. The Opus and T loops, without pre-activation had similar mechanical behaviour. A 10-degree preactivation bend created on all loops, except the Opus loop, resulted in an increase in the vertical and horizontal forces but eliminated the relative constancy of M/F. Changes in the size of the wire affected stiffness, but had little effect on M/F ratio. Decreasing the loop dimension increased the stiffness and decreased the M/F ratio in both the alpha and beta positions. Pre-activation bends created tipping followed by translation and continued by root movement
CONCLUSIONS: Geometric differences between the T and L loops significantly affected their mechanical behaviour but no significant difference was observed between the Opus and T loop. Decreasing the loop dimension decreased the M/F ratio. Variation in the size of the wire had little effect on M/F ratio.

272 BIOMECHANICAL AND CLINICAL INVESTIGATION OF ASYMMETRICAL HEADGEAR WITH AN INTERNAL HINGE IN CLASS II PATIENTS

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AIM. To assess the expected forces and moments following application of asymmetrical headgear with an internal hinge, to compare them with symmetrical or asymmetrical headgear without an internal hinge, and to investigate the clinical efficiency of the appliance during orthodontic treatment.
MATERIALS AND METHOD: Two six-component measuring sensors were used for the

biomechanical investigation. The dental casts of 97 patients, where an asymmetrical headgear with internal hinge was used, were evaluated at the beginning and end of treatment.
RESULTS: With asymmetrical headgear with an internal hinge, a distalizing component of 7.14 and 2.06 N was determined at the two headgear tubes, resulting in a gross difference of 5.18 N. The observed difference of the distalizing component between the right and the left side with asymmetrical headgear without an internal hinge or symmetrical headgear was 3.67 and 1.18 N, respectively. The main effect following application of an asymmetrical headgear was attributed to rotation of the molars as a result of the applied moments. There was a statistically significant total distalization of 5.5 mm during the entire treatment ($P < 0.001$), a fact that was independent of whether the first molar alone or together with the ipsilateral second molar were distalized simultaneously.
CONCLUSIONS: Asymmetrical headgear with an internal hinge is an effective appliance for the treatment of sagittal dentoalveolar discrepancies. The appropriate modification of the geometry of the facebow facilitates simultaneous unilateral distalization of both the first and second maxillary molars.

273 CLINICAL APPLICATION OF NEWLY DEVELOPED ARCHWIRES DURING ORTHODONTIC LEVELLING

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AIM: To determine the force magnitude applied during levelling of teeth with newly developed biostarter archwires. These are specially coated superelastic wires that reduce friction between brackets and archwires
MATERIALS AND METHOD: A measuring appliance was constructed comprising three brackets connected to a three-dimensional measuring megament gauge. Each gauge determined the forces and the moments applied on each bracket. For the purposes of this study several different archwires (stainless steel, twistflex, TMA, superelastic materials and the biostarters) were tested.
RESULTS. Only with the biostarters was an acceptable force below 0.5 N found. This was independent of the use of stainless steel ligatures or self-ligating brackets, and allowed levelling up to 6 mm. This force of 0.5 N was reduced to less than 0.3 N over a vertical distance of 6 mm when elastic ligatures were used.
CONCLUSION: For levelling of teeth, biostarter archwires are recommended together with elastic ligatures to avoid orthodontic forces exceeding 0.5 N. At subsequent appointments the elastic ligatures should be replaced by stainless steel ligatures to ensure that the applied forces do not exceed of 0.5 N.

274 HEAD POSTURE AND MORPHOLOGY IN OBSTRUCTIVE SLEEP APNOEA

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AIM: To measure craniofacial and head posture variables from lateral cephalometric radiographs, taken in standardized head posture, in subjects with obstructive sleep apnoea (OSA), to determine if differences exist between the study samples.
SUBJECTS AND METHOD: Sixty-one Chinese male subjects divided into mild and moderate-to-severe OSA groups. The mild OSA patients served as a reference group, because for ethical reasons no control sample was available. Linear and angular measurements were made that defined jaw relationships and head posture.
RESULTS: Significant differences were found between hyoid position for the moderate-to-severe OSA group when compared with the mild OSA sample. The hyoid was more caudally placed in the moderate-to-severe sample when measured to the mandibular border (ML; $P < 0.05$) and the maxillary plane (NL; $P < 0.01$) than in the mild OSA group. No significant differences were found for other craniofacial or head posture variables, so the data for the mild and moderate-to-severe OSA patients were pooled, and head posture variables were compared with existing control studies for both

Chinese and Caucasian subjects. This revealed a marked increase in cranio-cervical angulation for the total OSA study sample: cranio-vertical (NSL/VER), cranio-cervical (NSL/OPT) and cranio-horizontal (OPT/HOR) variables, when compared with each of the various control groups ($P < 0.001$). CONCLUSION: A more caudal hyoid position and greater cranio-cervical angulation are found in OSA subjects.

275 CEPHALOMETRIC EVALUATION OF A MODIFIED MAXILLARY PROTRACTION FACEMASK

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AIM: To examine the effects of a newly modified maxillary protraction face mask.
SUBJECTS AND METHOD: Fifteen patients (9 females, 6 males) with a mean age of 12.14 ± 1.96 years. All were skeletally Class III with a retrognathic maxilla and orthognathic mandible. For each patient, a hyrax expansion screw with a full coverage acrylic cap splint was constructed and rapid palatal expansion was performed for 7 days. At day 7, protraction therapy with the combination of a specially designed face bow and Petit type facemask was started. The face bow was bent upward to raise the point of force application to pass through the centre of resistance of the maxillary dento-alveolar complex and to have parallel application of the elastic force in both sides. A unilateral force of 500 g was applied and the patients were instructed to wear the facemask for 16 hours a day.
RESULTS: The average treatment time was 7.5 months. After the evaluation of the lateral cephalometric films, taken before and immediately after discontinuation of the use of the face mask and removal of the acrylic cap splint, the following results were obtained: point A moved anteriorly, on an average, 2.41 mm, the maxillary dento-alveolar complex translated anteriorly without any rotation, the maxillary occlusal plane showed a significant clockwise rotation and the maxillary incisors were extruded and retroclined. Downward and backward rotation of the mandible was also observed.
CONCLUSION: This new facebow design, which was modified from that introduced by Nanda (1980), resulted in a more effective system where the whole of the protractive force was utilized in protracting the maxilla, and the maxillary dento-alveolar complex was bodily protracted.

276 BILATERAL MAXILLARY MOLAR DISTALIZATION WITH A MODIFIED MOLAR SLIDER

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AIM: To move the upper first molars in distal direction without distal tipping and any need of patient co-operation.
SUBJECTS AND METHOD: Twenty-two patients (13 females, 9 males) with a mean age of 13.25 ± 1.53 years. All patients had no crowding of their lower arches and dentally a bilateral Class II molar relationship. They had a normal or low vertical growth pattern. No anterior bite plane was used and the diameter of the stainless steel wire, which was used as a guide for maxillary molar sliding, was increased to 1.2 mm as a modification of the Keles slider. The purpose of this increase in diameter was to prevent the molars from tipping and rotating during distalization. An 11 mm long Ni-Ti open coil spring, with a force of 150 g, was used to slide the molars distally. Lateral cephalograms and cast models were analysed before and after molar distalization. A non-parametric Wilcoxon signed rank test was used for statistical evaluation.
RESULTS AND CONCLUSION: The maxillary first molars were distalized an average of 3.92 ± 0.98 mm without any tipping or extrusion. The maxillary first premolars were mesialized, on average, 1.59 ± 1.44 mm, tipped 3.69 ± 4.98 degrees, and extruded 2.49 ± 1.28 mm. The maxillary central incisors were proclined on average of 1.2 ± 1.2 mm and tipped labially 3.59 ± 2.86 degrees. Model analysis showed that there was a 3.23 ± 1.21 mm increase in the transversal distance between the upper first molars, whereas the molars rotated disto-buccally 3.69 ± 4.98 degrees. First molar

distalization with acceptable anchorage loss and without the need for patient co-operation was achieved.

277 COMPLICATIONS DURING HERBST APPLIANCE TREATMENT WITH REDUCED MANDIBULAR CASTED SPLINTS

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AIM: To assess and compare the prevalence of complications during Herbst treatment with reduced and standard mandibular casted splints.
SUBJECTS AND METHOD: Fifty consecutive Herbst patients treated with reduced mandibular anchorage (canines to second premolars) were compared with 182 consecutively treated Herbst patients treated with total mandibular anchorage (canines to first or second molars) (Sanden *et al.* 2004). The average treatment time was 8 months in the reduced and 7 months in the total anchorage groups. Several practitioners at the Universities of Berne and Giessen performed the treatment. The frequency of telescope and/or splint breakages, as well as splint loosening, was derived from the patients' records.
RESULTS: The prevalence of patients without any complications did not differ significantly between the groups and amounted to 42 per cent in the reduced and 40 per cent in the total anchorage groups. The frequency of complications for the reduced and total anchorage groups, was, respectively, was: 8.3 per cent /4.3 per cent telescope breakages, 0 per cent /0.8 per cent maxillary splint breakages, 4.8 per cent /1.3 per cent mandibular splint breakages, 53.6 per cent /66.9 per cent maxillary splint loosening, and 33.3 per cent /26.8 per cent mandibular splint loosening.
CONCLUSION: Loosening of upper splints is the main complication during casted splint Herbst appliance treatment. A reduction in anchorage does not increase the prevalence of complications; it can thus be recommended for further use.

Sanden E, Pancherz H, Hansen K 2004 Complications during Herbst appliance treatment. Journal of Clinical Orthodontics 38:130-133

278 TREATMENT EFFECTS WITH THE INTEGRATED HERBST APPLIANCE: A COMPARISON IN THE LATE STAGE OF SKELETAL MATURATION

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AIM: To compare dentofacial changes obtained in boys and girls in a late stage of skeletal maturation after treatment with the integrated Herbst appliance (IHA; Haegglund and Segerdal, 1997).
SUBJECTS AND METHOD: From a group of 174 consecutive patients who had undergone treatment with the IHA, 18 boys and 35 girls who were in a late stage of skeletal maturation (stages R-I–R-J according to Hägg and Taranger 1980, 1982), were selected. At the start of the IHA treatment the mean ages were 16.5 years in the boys and 15.3 years in the girls. The ANB angle was ≥ 4 degrees and the overjet ≥ 6 mm in all patients. The average treatment time was 8.2 months in the boys and 9 months in the girls. Cephalometric lateral head films with the teeth in occlusion and with the mouth wide open, which had been taken before and after Herbst treatment, were used for analysis of skeletal and dental changes according to the method of Pancherz (1979, 1982). The variables investigated were: ANB angle; overjet; position of the maxillary and mandibular bases; mandibular length; lower incisor inclination and molar relationship.
RESULTS: The variables, mandibular base and mandibular length, increased significantly more in boys than in girls ($P < 0.01$ and $P < 0.05$, respectively. Overjet was more reduced in boys than in girls ($P < 0.01$). This gender difference, however, could probably be ascribed to the fact that the initial overjet in the boys was greater than in the girls. The changes recorded in the other variables did

not differ significantly between the genders.
CONCLUSION: Treatment with the IHA in patients who are in a late stage of skeletal maturation, has a more pronounced positive effect on mandibular length and position in males than in females.

279 INFORMED ORTHODONTIC CONSENT: A PROSPECTIVE, RANDOMIZED, CONTROLLED QUESTIONNAIRE BASED STUDY

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AIMS: To assess the influence of two different methods of information delivery (verbal and verbal supplemented with written) during the consenting process for orthodontic treatment, and to explore and compare the views of children and parents with regard to consent for orthodontic treatment.
SUBJECTS AND METHOD: Sixty-four patients starting orthodontic treatment with fixed appliances between 10 and 15 years of age, and their parents were recruited on the basis of predetermined inclusion criteria. The control group (n = 31) and their parents received verbal information regarding fixed appliance treatment. The study group of subjects (n = 33) and their parents received verbal supplemented with written information regarding fixed appliance treatment. Supervised completion of questionnaires was conducted with subjects and their parents immediately after the consenting process and subsequently to coincide with the first change of archwire approximately six weeks later. Themes within the questionnaire explored demographic details, dental awareness, previous dental experience, and issues of informed consent.
RESULTS: Patients who received verbal information supplemented with written information appeared to be better informed than those who received verbal information only with respect to certain aspects of fixed appliance treatment. Patient and parent groups as a whole shared similar views on aspects of consent to orthodontic treatment, the exception being the age of consent. Furthermore, the results suggest that children want to be involved in deciding about orthodontic treatment in conjunction with their parents and the orthodontist, thus taking part in joint decision-making.
CONCLUSIONS: It is recommended that verbal information given to patients about orthodontic treatment should be supplemented with additional written information. It is recommended that child orthodontic patients be encouraged to demonstrate their involvement in decision-making by giving written assent to treatment.

280 TWIN-SLOT BRACKETS – A NEW VISION IN THE EFFICIENCY OF TOOTH MOVEMENT

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APPLIANCE DESIGN AND FABRICATION: Two horizontal slots were set on the facial surface of the bracket, with the width in between being 0.4 mm. The size of the two slots was conventional 0.022×0.028 inch. The size of the bracket was 2×3.5 mm^2. The geometric form of the slots was traditional Edgewise fashion. The prototype of the design was manufactured and authorized for clinical trial. Working mechanisms: (1) Increased force moment: the setting of an additional slot theoretically results in as two folds of force moment the routine edgewise bracket, leading to an increased effectiveness in tooth movement control. (2) Enlarged force acting area: the separate engagement of two archwires into the two slots results in four contacting points, with which tooth movement is less likely to tip and rotate.
CLINICAL ADVANTAGES: (1) Main and auxiliary archwires: Twin-slot brackets accommodate two archwires separately, making the main and auxiliary-archwire mechanism works more efficiently. (2) Archwires combinations: two archwires with different properties (rigidity versus resilience), different shapes (round versus rectangular) or different sizes (small versus large) could co-exist to function respectively but harmoniously. (3) Flexible engagement: an asymmetrical engagement can be adopted where two archwires are employed in one dental arch with severe crowding, whilst a

single archwire to the other where an initial alignment is achieved. In subjects with a deep curve of Spee, a rectangular NiTi wire could be engaged into the occlusal slots at the labial segment and then transferred to gingival slots at buccal segment. Thus the archwire is activated into a reverse curve shape and could facilitate flattening of the curve of Spee.

281 SOFT TISSUE CHARACTERISTICS AND GENDER DIMORPHISM IN CLASS III MALOCCLUSIONS

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AIMS: To evaluate the aesthetic parameters of a sample of adult Greeks with Class III malocclusions, and to study possible sexual dimorphism of the soft tissues of this sample
MATERIALS AND METHOD: The pre-treatment lateral cephalograms of 57 patients (26 males, 31 females) with a Class III malocclusion, aged from 18 to 39 years. Descriptive statistics, parametric and non-parametric tests were used for the evaluation of the soft tissues and investigation of statistically significant differences between the genders. The error of the method was examined by double tracing of 30 randomly chosen cephalometric radiographs.
RESULTS: The Class III sample was characterized by negative convexity, a small H angle and upper lip curvature, and greater chin prominence. The Class III males presented greater nose prominence and upper lip curvature, a longer distance from subnasal to the harmony line, a more negative convexity of the profile, a thicker upper lip and larger upper lip strain compared with Class III females.
CONCLUSION: There are many differences in the soft tissue profile of Class III patients confirming gender dimorphism in this group.

282 EVALUATION OF NASAL VOLUME FOLLOWING RAPID AND SURGICALLY ASSISTED RAPID MAXILLARY EXPANSION

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AIM: The purpose of this study was to evaluate nasal volume changes using the acoustic rhinommanometry (AR) method following in rapid maxillary expansion (RME) and surgically-assisted RME (SARME).
SUBJECTS AND METHOD: The RME group consisted of 10 subjects with a mean age of 12.30 ± 0.8 years. The SARME group comprised 10 subjects with a mean age of 18.7 ± 2.54 years. Both groups had maxillary width deficiency with bilateral crossbites. Neither group had a history of nasal disease and all subjects presented with normal cavities on anterior rhinoscopic examination. The records, obtained with and without the use of a decongestant to increase reliability, were taken pre- and post-expansion [i.e. at the end of retention (6 months later)]. The data were evaluated using Mann-Whitney *U* and Wilcoxon's signed ranks test.
RESULTS: In the RME group the volume changes were statistically significant at both measurements (without decongestant $P = 0.005$, with decongestant $P = 0.011$). In the SARME group the volume changes were statistically significant in both measurements (without decongestant $P = 0.011$, with decongestant $P = 0.007$). There was no statistically difference between the RME and SARME groups (without decongestant $P = 0.45$, with decongestant $P = 0.79$).
CONCLUSIONS: Nasal volume was increased similarly in the RME and SARME groups, although the mean ages were different between the groups.

283 REDUCED *EIKENELLA CORRODENS* VIABLE COUNT DURING FIXED APPLIANCE THERAPY IN CHRONIC PERIODONTITIS

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AIM: To determine changes in the viable count of *Eikenella corrodens* (*E. corrodens*) in adults with chronic periodontitis undergoing orthodontic fixed appliance therapy. *E. corrodens* is a gram-negative, facultative anaerobic rod and regarded as one of the periodontal pathogens. This bacterium is not identified by conventional molecular biological test procedures.
MATERIALS AND METHOD: In seven adult patients who had undergone no antibiotic periodontal pre-treatment, *E. corrodens* was determined by microbiological cultivation. Using sterile paper tips, subgingival plaque samples were taken at three different treatment times from the deepest periodontal pocket of the sampled tooth (n = 76) (T1: before treatment was started; T2: 6 weeks after orthodontic treatment was started, T3: 6 weeks after removal of the fixed appliances). The subgingival plaque samples were stored at –80°C in 750 µl reduced transport fluid – transport medium. Statistical differences in the viable count at the different treatment times were determined by the Friedman test ($P < 0.05$).
RESULTS: The reduction of the viable count of *E. corrodens* from T1 to T3 was significant ($P = 0.001$). A continuous reduction in the bacterial count of the gram-negative rods was observed at T2.
CONCLUSION: A marked reduction of *E. corrodens* from T1-T3 was observed without any additional periodontal treatment. The marked reduction in the viable count of *E. corrodens* during fixed appliance therapy was attributed primarily to the release of metal ions.

284 TENSOR CEPHALOMETRIC ANALYSIS OF SKELETAL CHANGES IN THE MIDFACE AND MANDIBULAR REGIONS IN CHILDREN WITH NORMAL OCCLUSION

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AIM: To analyze the changes in craniofacial growth in children with normal occlusion and without orthodontic treatment by means of tensor analysis.
SUBJECTS AND METHOD: Craniofacial development of 31 untreated children with normal occlusion was followed over a period of 18 years. Lateral cephalograms were taken from 6 to 25 years of age, either annually or biannually, following which the subjects were grouped into eight age groups. The mean growth changes were calculated in relation to the youngest age group. Eighteen different triangles in the midface, mandibular, intermaxillary, dental and posterior face height region were analyzed using tensor analysis. A customized software program (ROTA II) was developed. Levene's and the Student's *t*-test were used for statistical analysis. The significance level was set at 5 per cent.
RESULTS: Moderate sagittal growth of the maxillary complex continuously increased with some mild growth peaks. These peaks contributed to the enlargement of maxillary length and the anterior caudal displacement of the maxilla before and during incisor eruption. Sagittal maxillary growth was consistent with sagittal development of the mandible prior to puberty. The highly significant increase in sagittal growth of the mandible changed the basal structures during puberty. The measurable sagittal growth in both arches resulted in a normal intermaxillary incisor relationship after puberty.
CONCLUSIONS: The data provides a database of the craniofacial development in untreated subjects with normal occlusion.

285 THE CRANIAL BASE AND SOFT TISSUE PROFILE IN PATIENTS WITH CLEFT LIP AND PALATE

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AIM: To evaluate characteristics of the cranial base and soft tissue profile in patients with a cleft lip and palate (CLP) and to compare these values with control group without a CLP.
SUBJECTS AND METHOD: Group 1 comprised 40 patients with CLP (20 UCLP, 20 BCLP) and group 2, 40 patients without a CLP. The average ages were 8 years 7 months and 8 years 3 months, respectively. For each patient study cast and profile cephalometric analyses were undertaken. The

following parameters were measured and analysed: cranial base angles, NSBa, SBaN and BaNS; linear parameters, NS, SBa and NBa; soft tissue profile, angles T and H, position, thickness and height of the upper and lower lip, chin thickness and vertical position of upper and lower lip and chin.
RESULTS: Patients with a UCLP had significantly smaller NSBa and SbaN angles, while in patients with a BCLP only SbaN was smaller. BaNS was significantly larger in CLP patients. The values for the distance, NS, was similar in the whole sample, while distances SBa and NBa were smaller in CLP patients. CLP patients had significantly smaller T and H angles. There were no changes in the position of the lower lip, while the upper lip was shorter and more distally positioned and the thickness of upper lip and chin was smaller in CLP patients.
CONCLUSION: CLP patients demonstrated some typical changes in the structures of the cranial base and soft tissue profile. The changes in the soft tissue structures were a consequence of existing scar tissue. Mostly, patients with clefts had typical concave profile with severe retraction of the upper lip.

286 DENTAL CLASS III – IS IT SKELETAL? A NON-RADIOGRAPHIC APPROACH TO IMPROVE INITIAL DIAGNOSIS

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AIM: To investigate if parameters characterizing skeletal Class III can be identified on profile photographs.
MATERIALS AND METHOD: Profile photographs and lateral cephalograms of 15 young adult males with a distinct dental Class III malocclusion and of 10 young adult males with a Class I occlusion. A computerized analysis of the lateral cephalograms and the profile photographs was performed. Statistical analysis aimed first to detect high correlations between soft tissue measurements and skeletal measurements revealed in the lateral cephalograms and then to correlate skeletal measurements with soft tissue values on profile photographs.
RESULTS: Certain soft tissue facial characteristics showed a very strong correlation to skeletal structures revealing the skeletal Class III cases. On the lateral cephalograms soft tissue A'N'B' was highly related to skeletal ANB ($r = 0.877$) and ANPog ($r = 0.846$). The soft tissue A'N'Pog' was highly related to skeletal ANPog ($r = 0.903$), and soft tissue N'-Sn/Sn-Pog' was highly related to skeletal ANB ($r = 0.866$) and ANPog ($r = 0.853$). All the statistical values were above $P < 0.001$. Similar correlations were found between the profile photographs and the above cephalometric measurements.
CONCLUSIONS: The evaluation of profile photographs can reveal skeletal Class III discrepancies and may be a useful diagnostic tool during consultation.

287 A RADIOGRAPHIC EVALUATION OF APICAL ROOT RESORPTION FOLLOWING INTRUSION THERAPY

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AIM: To evaluate whether patients treated with an additional upper utility arch show higher amounts of root resorption of the maxillary central incisors than those treated with a single straight-wire technique.
SUBJECTS AND METHOD: Sixty-seven patients, treated in a private orthodontic practice: 29 (group 1) were treated with an additional maxillary utility arch within the straightwire therapy (intrusion 15 g) and 38 (group 2) with a single straightwire fixed appliance. The amount of apical root resorption of the maxillary central incisors was determined for each patient by subtracting the post-treatment tooth length from the pre-treatment tooth length measured directly on cephalograms.
RESULTS: Root shortening of the maxillary central incisors was found to average 1.7 mm after using an additional maxillary utility arch (group 1) for 5 months (average) and a treatment time of 23.8 months. In group 2 root shortening was found to average 0.7 mm after a treatment time of 19.8

months (average). A Student's *t*-test showed the amount of root resorption between the two orthodontic techniques was significant.
CONCLUSIONS: Intrusion with the utility arch type of technique increases the amount of root resorption for the central maxillary incisors. The average amount of root resorption in both groups was, however, not clinically relevant.

288 PROJECTION ERROR AND MAGNIFICATION OF DIFFERENT CEPHALOSTATS
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AIM: A recent questionnaire survey revealed that 46 per cent orthodontists in the Czech Republic had changed the source of cephalograms during the past 10 years. The aim of this study was to determine the linear projection error in cephalostats of different manufacturers, and to evaluate the influence of projection error.
MATERIALS AND METHOD: On the basis of 77 cephalograms from 12 different machines, 10 cephalometric machines were selected. Repeated radiographs were obtained with the aid of the original phantom. Reference lines (70 mm) were chosen and compared with regard to enlargement and distortion of the radiographs. The correction coefficients were calculated.
RESULTS: As distortion did not exceed the error of the measurement, the radiographs were assessed as not distorted for clinical purpose. Enlargement fluctuated considerably, not only among different cephalostats but also between devices from a single manufacturer. The length of the reference line (70.00 mm) increased on radiographs from analogue machines from a minimum of 73.38 mm to a maximum of 81.20 mm (mean 77.95 mm, range 7.82 mm). The percentage increase was from 4.82 per cent (minimum) to 16.00 per cent maximum (mean 11.30 per cent, range 11.18 per cent). The mean coefficient of magnification was 1.11 (minimum: 1.05, maximum: 1.16, and range 0.11 among different machines). The digital X-ray output differed to a large extent from other machines as a consequence of software internal conversion (length 70.41 mm, percentage increase 0.58 per cent, and coefficient of magnification 0.01).
CONCLUSION: Cephalograms from different cephalostats may substantially vary in magnification size.

289 A STUDY OF THE HUMAN JAW USING IN-PLANE ELECTRONIC SPECKLE PATTERN INTERFEROMETRY WITH AN OPTICAL FIBRE SYSTEM
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AIM: A new electronic speckle pattern interferometry (ESPI) system for the measurement of in-plane displacement was used on a human jaw. This set-up makes possible the study of objects with complex geometries, which have deformations with unknown symmetry.
MATERIALS AND METHOD: In the experimental set-up a He-Ne laser of 35 mW (Uniphase 1144P), incident into a 1 × 2 monomode fibre optical coupler was used. This coupler splits the light from the laser into two beams of equal intensity that can be directed towards the object under study – a human mandible. The two extremes of the optical fibre are attached to a motorised rotational platform with an angular precision of 0.0001 degrees.
RESULTS: Static study: There were two different areas where the fringes presented a different shape: the ramus and corpus. The angle observed in the rotation was 21.0 sd: 1.5 arc seconds. For the corpus the fringes obtained were vertical. Dynamic study: For the ramus it was clearly observed that the separation between the fringes increased with the value of the pressure applied. When the pressure varied, the inter-fringe separation in the ramus or corpus decreased.
CONCLUSIONS: The main advantage of this system is the simplicity in introducing changes in the configuration of the experimental set-up. It has greatly simplified the assembly of an ESPI system for in-plane measurements, to the point where there is only one critical stage left in the assembly of the

system: the coupling between the laser and the fibre optic.

290 PROSPECTIVE EVALUATION OF AN ORTHODONTIC APPLIANCE IN THE TREATMENT OF OBSTRUCTIVE SLEEP APNOEA

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AIM: To investigate the effects of an oral appliance (OA), with and without mandibular advancement, in the treatment of obstructive sleep apnoea (OSA).
SUBJECTS AND METHOD: Twenty-four patients diagnosed with OSA agreed to participate. The patients were treated for 3 months (a removable soft elastic silicone positioner customized with thermoplastic silicone and with a 5 mm opening and 75 per cent advancement). Using a randomized design, patients were selected to receive either the OA model with (12 patients) or without (12 patients) advancement. Before treatment, a snoring questionnaire, Medical Outcomes Study 36-Item Short-Form Health Survey (SF-36), Functional Outcomes of Sleep Questionnaire (FOSQ), Epworth Sleepiness Scale (ESS) and polysomnography were completed.
RESULTS: Fifteen subjects completed the protocol (13 males, 2 females). With respect to basal values, the mandible in the advanced OA group showed a decrease in the mean apnoea-hypopnoea index (AHI) (33.8 ± 4.7 versus 9.6 ± 2.1; $P < 0.01$), number of arousals per hour (33.8 ± 13.9 versus 16.0 ± 1.5; $P < 0.05$), ESS score (14.7 ± 5.1 versus 5.1 ± 1.9; $P < 0.05$), snoring score (15.4 ± 1.9 versus 10.1 ± 3.2; $P < 0.05$) and total FOSQ score (78.1 ± 22.6 versus 99.3 ± 14.4; $P < 0.05$). After treatment the non-advanced mandible OA group presented a decrease in the mean AHI (24.0 ± 12.2 versus. 11.7 ± 7.9; $P < 0.05$). However, no significant differences were found in the number of arousals per hour, ESS score, snoring, and total FOSQ score in the non-advanced OA group. Neither group showed a significant difference in mean SF36 scores.
CONCLUSIONS: Orthodontic appliances, such as bimaxillary positioners that open and advance the mandible (75 per cent), offer an effective treatment for OSA.

291 MOLAR DISTALIZATION – EFFECTS OF TWO DISTALIZATION APPLIANCES

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AIM: To evaluate the dentoalveolar effects of a modified Distal Jet (MDJ) and Fast-Back (FB) appliances on upper molar distalization.
SUBJECTS AND METHOD: Twenty-seven patients (15 MDJ and 12 FB) were included. The age of the patients ranged between 10 years 4 months to 15 years 3 months. With these appliances, the adjustment of the line of action of force in relation to the centre of resistance (CR) of the upper molar is possible. Thus, the lines of action of force were passed through the CR of the upper molars in all subjects. Twenty-six parameters were measured to analyze the changes on pre- and post-distalization lateral cephalograms. Comparison of pre- and post-distalization values were undertaken with the Wilcoxon test. Comparisons of the changes between the groups were made with the Mann-Whitney *U* test.
RESULTS: In both groups the increase of anterior face height and extrusion of the first premolars were significant ($P < 0.01$). In the MDJ group, anterior movement and anterior tipping of upper incisors (1.33 mm, 0.63 degree), anterior movement of first premolars (2.20 mm), distal movement and distal tipping of first molars (3.07 mm, 9.67 degrees) were significant ($P < 0.001$). In the FB group, anterior movement and anterior tipping of the upper incisors (1.84 mm, 0.68 degrees), anterior movement of first premolars (2.63 mm) and distal movement of the first molars (2.93 mm) were significant ($P < 0.01$). Distal tipping of the first molars was statistically significantly different between the groups.
CONCLUSION: In both groups, the anchorage teeth (first premolars) moved anteriorly and extruded; the first molars moved and tipped distally. However, in the FB group, the distal tipping of the first

molars was not significant. It can be concluded that more controlled molar distalization is obtained with the FB appliance.

292 LONG-TERM FOLLOW-UP OF ORTHODONTIC TREATMENT OF BIMAXILLARY CROWDING

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AIMS: To evaluate how former orthodontic patients remember their treatment period and, additionally, to study post-treatment changes.
SUBJECTS AND METHOD: Seventy-four individuals who had finished treatment 6-14 years previously (mean: 9 years) answered a questionnaire regarding their orthodontic experiences. Among them 35 were clinically examined and study casts were obtained. The casts were measured using a digital calliper. Possible crowding was evaluated using Little's index.
RESULTS: The questionnaire showed that the individuals were happy with their present dentition, even though 11 experienced some dissatisfaction with the relapse in irregularity of their anterior teeth. Sixty-two (85 per cent) would, if needed, go through treatment again. They all wanted their children to be orthodontically treated. Eleven individuals were out of retention, and 24 still had bonded anterior retainers in the upper and/or lower arch. In subjects without retention, Little's index was 0.75, indicating slight crowding. In individuals with a bonded retainer, the intercanine distances were changed as well as the overbite and overjet. Even some relapse of crowding was measured.
CONCLUSION: The patients considered that orthodontic treatment was worthwhile. Minor changes in the dentition were measured even in those with bonded retainers.

293 INCREASED OVERJET AND PERCEIVED NEED FOR ORTHODONTIC TREATMENT

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AIM: To investigate the need for orthodontic treatment, as perceived by a group of graduate dental students and a group of orthodontists, in cases where increased overjet size is the major malocclusion trait.
MATERIALS AND METHOD: Twenty-five pre-treatment dental casts of orthodontic subjects selected from the files of the Postgraduate Orthodontic Clinic, University of Athens, representing the full range of severity of malocclusion, according to all 1-5 grades of the Index of Orthodontic Treatment Need (IOTN). Six cases presenting variable degrees of increased overjet as the major malocclusion trait were included in a random order in the sample. Fifty randomly selected graduate dental students and 30 orthodontists were asked to rate the study models separately, with respect to each case's perceived need for orthodontic treatment, according to a 1-5 scale. Differences between the two groups' ratings were assessed and their statistical significance was tested by means of the Chi-square criterion.
RESULTS: For all cases presenting a variable degree of increased overjet, the ratings of the orthodontic group were higher than those of the graduate students. However, a statistically significant difference was recorded only for the two cases with minimal overjet and minor need for orthodontic treatment, as assessed by the IOTN or Dental Aesthetic Index. A greater variance in the graduate students' ratings was recorded for all cases.
CONCLUSIONS: The observed variation of the graduate students ratings underlie the need for improved education in order to calibrate their diagnostic methodology according to more objectively defined criteria. The accurate assessment of cut-off points for the indicated orthodontic treatment need, require further investigation of the validity and reliability of occlusal indices in the Greek specialist and non-specialist community.

294 CLINICAL EVALUATION OF A GLASS FIBRE MATERIAL USED FOR LINGUAL RETENTION IN ORTHODONTICS

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AIMS: To evaluate the use of a resin composite retainer, reinforced with glass fibre (everStick® Ortho, Sticktech), for daily orthodontic practice, and to determine the reliability for long-term retention in the mandibular and maxillary anterior segment after orthodontic treatment.
SUBJECTS AND METHOD: Ninety patients received an everStick® Ortho from canine to canine in the lower arch and from the lateral to lateral incisor in the upper arch. Group I received everStick® Ortho containing 1000 individual glass fibres and group II an everStick® Ortho with 500 individual glass fibres. The control group consisted of 90 patients, bonded with a coaxial-wire (0.0215 inch, Ortho-organizers®). All retainers were bonded, after sandblasting and etching, by three different orthodontists, with the same standardized protocol. Six months after placement, all retainers were inspected in order to detect any possible failure.
RESULTS: After six months, 47 of 170 inspected composite retainers showed a failure, while only three of the 156 coaxial retainers failed. In group I the failure rate was 29 per cent (13/45) in both upper and lower arches. In group II the failure rate was 30 per cent (12/40) in the lower arch and 22.5 per cent (9/40) in the upper arch. In the control group the failure rate was 1.3 per cent (2/156) in the upper and 0.6 per cent (1/156) in the lower arch. A statistically significant difference ($P < 0.001$) was found between the control group and the two test groups. No statistically significant differences were found between groups I and II. The most frequent failure in the upper arch was a broken everStick-retainer. In the lower arch failure was mostly observed at the composite-enamel interface.
CONCLUSION: The reliability of everStick® Ortho retainers is minor compared with those of coaxial wires. Composite reinforced retainers are still not recommended for daily use in orthodontic practice.

295 DOES CLINICAL EXPERIENCE INFLUENCE THE CONSISTENCY OF ORTHODONTIC DIAGNOSIS?

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AIM: To test the effect of clinical experience on the consistency of sagittal and vertical orthodontic diagnoses performed by multiple examiners.
MATERIALS AND METHOD: Pre-treatment records of 88 orthodontic patients were evaluated independently by 12 orthodontists assigned to four groups on the basis of their clinical experience. The following diagnostic records were used: model casts, facial photographs, a panoramic radiograph, and a lateral cephalogram with its tracing. The diagnostic data regarding vertical diagnosis were ordered in five categories: hypodivergent, normodivergent, hyperdivergent, hyperdivergent tendency, hypodivergent tendency. For sagittal diagnosis the patient's maxillary and mandibular jaws were categorized as: normal, protruded, retruded, retrusion tendency or protrusion tendency. Inter-examiner agreement was calculated using Cohen's weighted kappa coefficient.
RESULTS: Vertical diagnoses data showed good agreement among the examiners. Sagittal diagnoses were less consistent, with poor agreement for the sagittal position of the upper jaw and moderate agreement for the sagittal position of the lower jaw. The consistency of all diagnoses was not influenced by clinical experience.
CONCLUSION: Clinical experience does not have any influence on the consistency of orthodontic diagnosis. Since a clear diagnostic evaluation of a patient's problem is important for effective and efficient treatment planning, there is a need for clearer definitions of diagnostic criteria.

296 DENTAL ARCH DIMENSIONS, SPACE CONDITIONS AND HEAD POSTURE

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AIM: To investigate the inter-relationship between dental arch dimensions, space conditions and head

posture.
SUBJECTS AND METHOD: Fifty-nine subjects (23 boys, 36 girls with a mean age of 13.2 years) who had not received previous orthodontic treatment, had all permanent teeth fully erupted, and standardised lateral cephalometric radiographs and study models available. Measurements were made on the dental study models using a digital sliding calliper to determine the arch length and space discrepancy by recording the greatest mesio-distal dimensions of the teeth and the dental arch perimeters in the maxilla and mandible. The lateral cephalometric radiographs were taken in standardized head posture, and postural variables represented by cranio-vertical (NSL/VER, NL/VER) cranio-cervical (NSL/OPT, NSL/CVT, NL/OPT, NL/CVT), cervico-horizontal (OPT/HOR, CVT/HOR), and cervical curvature angulations (OPT/CVT) were measured. Statistical comparisons were then made to upper and lower dental arch dimensions.
RESULTS: There were statistically significant negative correlations ($P < 0.05$) between the cephalometric measurements for head posture and measurements of dental arch perimeters. The lower anterior dental arch perimeter however showed the strongest negative correlation ($P < 0.01$) when compared with cranio-vertical (NSL/VER) and cranio-cervical (NSL/CVT) angulations. No pattern of association was seen between tooth size and any of the head posture variables.
CONCLUSION: These findings support the existence of a growth co-ordination mechanism relating head postural variables to maxillary and mandibular development and dental arch length. Subjects with increased head postural angulations tended to have smaller arch perimeters and more crowding.

297 SEVERE HYPODONTIA: IDENTIFYING PATTERNS OF TOOTH AGENESIS
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AIM: To explore if unique patterns of tooth agenesis can be identified in patients with severe hypodontia.
MATERIALS AND METHOD: Severe hypodontia (agenesis of six or more permanent teeth, excluding third molars) was diagnosed in 92 Caucasian subjects (37 females, 55 males) by means of panoramic radiographs and dental records. A new mathematical procedure was developed, in which unique numbers were assigned to all possible combinations of missing teeth. Chi-square tests were used to test for equal distribution of frequencies across categories and Student's *t*-tests to assess differences in mean scores.
RESULTS: The total number of missing teeth per individual ranged from 6 to 22 (mean 11.6, median 10.0, SD 4.35). No gender difference in the mean number of missing teeth in either jaw was found ($P > 0.05$). Bilateral tooth agenesis was observed in 87 per cent of all missing teeth. No significant difference in the frequency of agenesis could be found between contralateral teeth. Because of the high level of intra-arch symmetry (left versus right), the analysis was restricted to one quadrant (e.g. the upper right arch) and the results of contralateral quadrants were combined. The most common combination in the maxilla was bilateral agenesis of the lateral incisors and all premolars (14 per cent). For the mandible, bilateral agenesis of all premolars was most common (11 per cent). For the total dentition the most common combination (19 per cent) was bilateral agenesis of the maxillary lateral incisors, all maxillary premolars, central mandibular incisors and mandibular second premolars. The most common combinations of tooth agenesis were found significantly more frequently than the remaining combinations.
CONCLUSIONS: Tooth agenesis in severe hypodontia displayed a high level of intra-arch symmetry. Specific patterns of tooth agenesis have been successfully identified using a new mathematical procedure.

298 CEPHALOMETRIC STANDARDS FOR A SWEDISH POPULATION – A LONGITUDINAL STUDY BETWEEN 5 AND 31 YEARS OF AGE
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AIM: To establish age- and gender-specific cephalometric normative data for a Swedish population.
MATERIALS AND METHOD: Four hundred and sixty nine lateral cephalograms from two groups of subjects of Swedish origin between the ages of 5 and 31 years. All subjects (males and females) were diagnosed as 'normal' according to specified criteria and with no history of orthodontic treatment. Lateral cephalograms and body height measurements were taken at 5, 7, 10 and 13 years of age in one group (longitudinal follow-up). The same registrations were made in the other group at 7, 10 and 13 years of age (mixed longitudinal type). Those 13-year olds were re-examined at 16, 19 and 31 years of age (longitudinal follow-up). As no significant differences between age groups in the two samples were found, subjects of the same age were combined. The study hence is regarded as a longitudinal follow-up from 5 to 31 years of age. The subjects were also grouped into dental development stages to widen the applicability of the cephalometric data.
RESULTS: The craniofacial distances were constantly larger in males than in females, while no statistical differences as regards angular measurements were seen between genders. Distances and angular measurements varied with the different developmental periods.
CONCLUSION: Facial pattern changes existed during the observation period with a growth acceleration of most distances between the 13- and 16-year recordings. Thus, cephalometric standards for gender and age of ethnic groups are of importance in orthodontic diagnosis, treatment planning, and evaluation of the treatment, even after the post-retention period.

299 ANCHORAGE DURING INTRA-ARCH DISTAL MOLAR MOVEMENT

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AIM: To retrospectively evaluate and compare the anchorage provided with the Nance appliance (NA) and the fixed frontal bite plane (FBP) during intra-arch distal molar movement.
SUBJECTS AND METHOD: After sample size calculation, 20 patients were obtained and randomly selected for each group from subjects that fulfilled the following criteria: use of an intra-arch NiTi coil appliance with either NA or FBP to provide anchorage during a 6 months' molar distalization period, no orthodontic treatment before molar distalization, and first and second maxillary molars in occlusion. The outcome measures assessed were anchorage loss, i.e. anterior movement of maxillary central incisors, distal movement of maxillary molars and bite opening effect. The mean age in the NA group was 14.7 years (SD 1.09) and in the FBP group 15.0 years (SD 0.99).
RESULTS: The data revealed that the maxillary central incisors moved anteriorly 1.4 mm in the NA group and 1.9 mm in the FBP group. The difference in anchorage loss was not significant. The mean amount of molar distalization within the maxilla was 1.7 mm in the NA group and 1.8 mm in the FBP group. In both groups the overbite was significantly reduced and the overbite was decreased significantly more in the FBP group.
CONCLUSIONS: Since neither the NA nor FBP provided stable anchorage, a second treatment phase is recommended to reverse the anchorage loss after distal molar movement. If molar distalization is planned in deep bite cases, the FBP is the anchorage system of choice.

300 ORTHODONTIC SPACE MAINTENANCE WITH GLASS FIBRE BEFORE IMPLANT REHABILITATION

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AIM: To evaluate a new proposal for space maintenance in adolescents selected for implant rehabilitation, and to verify their satisfaction and clinical outcome.
SUBJECTS AND METHOD: Ten patients (5 males, 5 females) aged between 12 and 17 years with lateral incisor agenesis. All patients were evaluated for oral hygiene level (periodontal index and

radiographs), for growth index (age, external physiognomy, dentition and radiographs). For space maintenance and aesthetics, glass prosthetic fibres were used (StickTech; Micerium Spa, Italy) were used to recreate the missing teeth. The patients were interviewed concerning aesthetic satisfaction, and underwent clinical evaluation every 6 months.
RESULTS: After 12 months only one had patient lost the space maintenance composite tooth due to an accident (during the 4th month). At the first clinical evaluation after 6 months three patients required oral hygiene instruction. All patients accepted the method without discomfort or adverse side-effects and were satisfied with the result.
CONCLUSIONS: This technique seems to be easy to use and requires only one appointment.

301 *IN VITRO* ANALYSIS OF THE BIOLOGICAL REACTION TO BIOMATERIALS
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AIM: To compare the different standard and no standard techniques to evaluate the biocompatibility of dental alloys and to define the different influential parameters: preparation of the surface and of the trial sample, different types of materials and different methods of assessment.
MATERIALS AND METHOD: Three types of alloy were used [stainless steel (SS), cobalt-chromium and nickel-titanium (Ni-Ti)] which were square shaped (1 cm^2) and approximately 1 mm thick. They were in contact with primary human culture of pulpal and gingival fibroblasts for 7 days. The observations were made on days 1, 3, 5 and 7.
RESULTS: At all observation periods the SS alloy had more corrosion resistance than cobalt-chromium alloy. Both had minor corrosion defects when compared with NiTi alloy. At days 1 and 3 there was a halo of inhibition around all the alloys, at day 5 the halo of inhibition was steady, and at the last observation there was no inhibition of cellular growth.
CONCLUSIONS: Surface preparation of specimens influences biocompatibility testing.

302 LOWER ANTERIOR INCISOR TIPPING DURING FIXED FUNCTIONAL COMPARED WITH MANDIBULAR ANTERIOR REPOSITIONING**
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AIM: To examine the difference in anterior tipping of the lower incisors caused by the fixed functional mandibular anterior positioning appliance (MARA) with other fixed functionals (FF), such as the Herbst.
SUBJECTS AND METHOD: Fifty-one young healthy patients in the late or early permanent dentition were treated with full mouth fixed appliances and the MARA for a Class II malocclusion and then retained for at least two years. The patients treated with the MARA appliances had lateral cephalograms taken using the same cephalograph at the beginning, at the end of MARA treatment, and after retention. The radiographs were traced by two independent orthodontists and the results compared with the findings of other studies on the amount of tipping with various FF appliances.
RESULTS: There was 1.1 mm less protrusion with the MARA, which was significantly less than with other FFs.
CONCLUSIONS: If lower anterior increased protrusion is undesirable, it appears that the MARA is the appliance of choice.

303 PERIODONTAL CONSIDERATIONS IN NON-BONE GRAFTED CLEFT LIP AND PALATE PATIENTS
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AIM: To evaluate the periodontal conditions, after canine eruption and orthodontic treatment, in a borderline group in of cleft lip and palate (CLP) patients in order to clarify the need for bone grafting.
SUBJECTS AND METHOD: Ten CLP patients (6 females, 4 males, mean age 16.8 years) without

bone grafts. Probing depth, keratinized gingival width, recessions and gingiva/mucosa aspect in the cleft area were evaluated after canine eruption and orthodontic treatment. Periodontal status was assessed by clinical examination (probing) and radiographic examination (postero-anterior, occlusal, panoramic views).
RESULTS: Six of the borderline patients had significant periodontal defects.
CONCLUSIONS: A bi-dimensional radiographic examination is not always sufficiently accurate to evaluate the bone grafting need in CLP patients. Alternatives are being considered: (1) a computed tomographic examination to locate precisely the bone defect; (2) stem cell grafting or just remodelling of the alveolar gingiva and mucosa if a bone defect is not found.

304 CHANGES IN UPPER ARCH WIDTH AND SYMMETRY DURING FIXED ORTHODONTIC TREATMENT

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AIM: To evaluate, in a pilot study, the upper arch width and symmetry in extraction and non-extraction subjects during fixed orthodontic treatment.
SUBJECTS AND METHODS: Fifty patients, treated with MBT fixed orthodontic appliances. In 25 patients upper and lower first premolars were extracted, while in the remaining patients no extractions were performed. Brackets (0.022 inch) were used and treatment was finished with 0.019 × 0.025 inch preformed stainless steel archwires. Pre- and post-treatment orthodontic casts were used to evaluate the changes of upper arch width and symmetry. For this purpose, a midline of the upper casts along the palatine raphe was constructed. These casts were scanned and measurements were performed on their digital images. The distances between the left and right teeth were measured. Furthermore, the distances between the left and right teeth to the midline were measured. Comparison of pre- and post-treatment values was made with the *t*-test.
RESULTS: In both groups bilateral and bicanine widths increased ($P < 0.001$ and $P < 0.05$, respectively). In the extraction group the arch width between the second premolars and between the first molars decreased ($P < 0.001$). In the non-extraction group the arch width between the first premolars and second premolars increased ($P < 0.001$). The changes of arch width between the second premolars and first molars showed significant differences between the groups ($P < 0.001$). No arch asymmetry was observed for posterior teeth in either group. In the extraction group the distances between the left and right centrals to the midline and between the left and right laterals to the midline showed significant differences at the beginning of treatment ($P < 0.05$).
CONCLUSION: The mode of treatment, i.e. extraction or non-extraction, has opposite effects on posterior arch width. However, arch symmetry is not affected by the mode of treatment.

305 THE EFFECT OF LONG-TERM REPEATED DEFLECTIONS ON FATIGUE OF PRELOADED SUPERELASTIC NICKEL-TITANIUM ARCHWIRES

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AIM: To investigate, *in vitro*, the changes in force delivery of superelastic nickel-titanium archwires used in combination with a self-ligating bracket system after dynamic fatigue loading in a three-bracket model at 37°C.
MATERIALS AND METHOD: Two nickel-titanium, one Nitinol Classic and one stainless steel wire, 0.014 inch round, were divided into two groups: 'static deflection' (control group) and 'dynamic deflection' (test group). The static specimens were under a constant deflection of 3.0 mm. The dynamic specimens were subjected to repeated deflections (0.5 mm) after preloading with a deflection of 3.0 mm. Repeated deflections were applied by a fatigue tester. The test situation simulates a patient's archwire under deflection and subjected to occlusal contact during 1, 100, 10,000 and 100,000 times. Fatigue changes were assessed with a three-point bending test.
RESULTS: Wire, loading or unloading, deflection, and fatigue as well as within-subject factors were

statistically significantly different. No statistically significant difference between the test condition, static versus dynamic, was found. The repeated deflections of 0.5 mm were not sufficient to induce extra effect of fatigue.
CONCLUSION: From a clinical perspective, occlusal forces transferred to a considerably deflected archwire, such as in the large malalignments in the early stages of orthodontic treatment, will have no fatigue effect on the (unloading) force of that archwire.

306 A MATHEMATICAL MODEL TO PREDICT THE NEED FOR ORTHODONTIC TREATMENT OF COMPLETE UNILATERAL CLEFT LIP AND PALATE SUBJECTS
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AIM: To assess the need for orthodontic treatment of complete unilateral cleft lip and palate (UCLP) patients and to optimise the treatment in the early mixed dentition stage.
SUBJECTS AND METHOD: Forty patients (mean age 6.35 ± 0.44 years) with congenital non-syndromic complete UCLP were examined according to the treatment plan and data collection questionnaire. Three-dimensional measurements of the maxillary diagnostic models were carried out. Dental arch relationship anteroposteriorly was assessed according to the 5-year-old index, and analysis of occlusion and the form of the maxillary dental arch by assessment of the degree of posterior and anterior crossbite according to a modified Huddart and Bodenham assessment scale (Heidbuchel). Stepwise discriminant statistical analysis was performed using software packages SPSS 10.1, NCSS 2000 and PASS 2000.
RESULTS: The length of maxillary dental arch proved to be the most credible morphological criterion for evaluation of occlusion anteroposteriorly (77.1 per cent prognostic value) and the width of maxillary dental arch in the area of second primary molars for evaluation of the occlusion transversally (78.8 per cent prognostic value) in children with complete UCLP in order to predict orthodontic treatment need during the mixed dentition period.
CONCLUSIONS: Effective treatment planning would allow patients to avoid secondary deformation of dental arches and malocclusions as well as to minimize treatment time and costs. Long-term follow-up is required in order to confirm the effectiveness of cleft care.

307 TOOTH AGENESIS IN A GREEK ORTHODONTIC POPULATION
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AIM: To investigate tooth agenesis in the Greek population
SUBJECTS AND METHOD: Seven hundred orthodontic patients treated during 1992-2002. The prevalence of tooth agenesis in this orthodontic population was estimated to be 8.7 per cent. Patients with third molar agenesis or orofacial clefts were excluded. The tooth agenesis patients were divided in to four groups: anterior tooth agenesis, posterior tooth agenesis, a combination of anterior and posterior agenesis, and severe tooth agenesis.
RESULTS: Anterior tooth agenesis, consisting mainly of upper and lower incisor agenesis, was found in 41 per cent of the agenesis subjects. Posterior tooth agenesis, namely, premolar agenesis was estimated to be present in 29 per cent. A combination of antero-posterior agenesis and severe tooth agenesis was seen in 15 per cent. Anterior tooth agenesis presented the highest incidence, while lower incisor agenesis was found to be higher than expected. As far as gender was concerned, no single trait was detected. There were more females in the premolar and antero-posterior agenesis groups, whereas more males were found in the anterior and multiple agenesis groups.
CONCLUSION: As research becomes an integral part of dentistry, clinical observations stemming from epidemiological studies may prove to be of benefit in determining the genetic parameters of common dental conditions.

308 A NEURAL NETWORK BASED SYSTEM TO SUPPORT CLINICAL DECISION MAKING

IN ORTHODONTIC EXTRACTIONS

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AIM: To develop an intelligent computational system based on artificial neural networks (ANNs) to support clinical decision making in orthodontic extractions.
MATERIALS AND METHOD: Thirty-three variables related to age and gender, objective clinical evaluations, dental and cephalometric measurements were collected from 150 treated patients (96 females, 54 males, mean age 13.4 years, range 8.0-26.0 years). The main inclusion criterion was the achievement of long-term excellent occlusal and aesthetic treatment goals. The 33 input variables and the outcome variable (extraction versus non-extraction) were used to train a feed-forward back-propagation ANN. The ANN was trained using 14 different configurations. The ANN performance (success rate) was assessed as the proportion of correct classifications over the total number of cases presented to the ANN.
RESULTS: The success rate was, in general, high with most ANN configurations, as it ranged from 85.3 to 92.0 per cent.
CONCLUSIONS: An ANN can provide valuable support in whether or not to extract as part of an orthodontic treatment plan.

309 *IN VITRO* EVALUATION OF THE MATERIAL CHARACTERISTICS OF STAINLESS STEEL AND BETA-TITANIUM ORTHODONTIC WIRES

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AIM: Metal alloys of varying composition are in daily use in orthodontics. Mostly, the exact composition and material properties are unknown or not available from the manufacturer. This makes meaningful comparisons between wires impossible and, with regard to biocompatibility issues, this is unacceptable. The aim of the present study was to investigate and compare the material characteristics of contemporary stainless steel (SS) and beta-titanium (β-Ti) wires.
MATERIALS AND METHOD: Twenty-two different SS and β-Ti archwires, preferably straightwire and sized 0.43 × 0.64 mm (0.017 × 0.025 inch) were tested on a blind basis for wire dimensions, chemical composition, bending and tensile properties, and surface characteristics.
RESULTS: β-Ti wires can be divided into four groups of different chemical composition: Ti11.5Mo-6Zr-4.5 Sn; Ti-3Al-8V-6Cr-4Mo-4Zr; Ti6Al-4V and Ti-45Nb. The SS wires are of the AISI type 304 or the Ni-free variant BioDur® 108. The surface roughness values of all β-Ti wires were very high. TMA 02 significantly showed the highest E-modulus, TMA 02 and TMA 11 had the highest 0.2 per cent yield strength, TMA 02 the highest hardness, and TMA 12 was the most ductile wire of all β-Ti wires. All SS wires showed a very high 0.2 per cent yield strength, SS 10 significantly displayed the lowest E-modulus and was the most ductile wire, while SS 08 significantly demonstrated the lowest hardness values of all SS wires.
CONCLUSIONS: Comparing SS with β-Ti wires, significant differences were found, but with little or no difference between the mechanical or physical characteristics within each subgroup. However, morphological analysis demonstrates that the finishing phase (annealing, polishing, etc.) of the wire production process does not yield the essential quality for good mechanical properties and biocompatibility. An urgent need exists for accurate specifications concerning the quality of orthodontic wires on the market.

310 SHEAR BOND STRENGTH OF PRECOATED AND UNCOATED BRACKETS USING A SELF-ETCHING PRIMER SYSTEM

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AIM: To compare the shear bond strength (SBS) and the adhesive remnant on the tooth after debonding of APC Plus precoated brackets (3M Unitek) and uncoated brackets bonded with

Transbond XT (3M Unitek), conditioning the enamel in both cases with Transbond Plus Self Etching Primer (TSEP; 3M Unitek).
MATERIALS AND METHOD: The brackets were bonded to extracted premolars (n = 40), which were divided into two groups: 1) TSEP/Transbond XT, and 2) TSEP/APC Plus. SBS was measured using a universal testing machine. The adhesive remnant on the tooth was quantified using image analysis equipment. Scanning electron microscopy (SEM) was also carried out to observe the enamel surface treated with TSEP.
RESULTS: No significant differences were observed in SBS between the two groups ($P = 0.12$). TSEP/APC Plus left significantly less adhesive on the tooth than TSEP/Transbond XT ($P = 0.01$). SEM observations of the enamel treated with TSEP showed a porous and potentially retentive etch pattern for orthodontic bonding.
CONCLUSION: APC Plus is a good alternative to traditional bonding. The use of APC Plus precoated brackets with TSEP reduces chairside time without compromising bond strength.

311 EFFICIENCY OF REDUCED MANDIBULAR CASTED SPLINT ANCHORAGE IN HERBST TREATMENT

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AIM: To analyse the efficiency of reduced (second premolar to second premolar) mandibular casted splint anchorage in comparison with total (molar to molar) casted splint anchorage in Herbst treatment.
MATERIALS AND METHOD: Lateral head films of 42 Class II patients with reduced mandibular anchorage and of 52 Class II patients with total mandibular anchorage were analysed before and directly after Herbst treatment. The amount of lower incisor proclination and incisal edge advancement was used as a measurement for anchorage loss.
RESULTS: The lower incisors proclined more ($P < 0.001$) in the reduced (12.5 degrees) than in the total (9.4 degrees) anchorage group. The lower incisal edge, however, advanced less ($P < 0.05$) in the reduced (3.0 mm) than in the total (3.6 mm) anchorage group.
CONCLUSION: Reduced and total mandibular casted splint anchorage seem to be similarly efficient. Anchorage loss measured by mandibular incisor proclination was larger in the reduced anchorage group whereas incisal edge advancement was larger in the total anchorage group.

312 CONDYLAR EFFECTS WITH STEPWISE MANDIBULAR ADVANCEMENT VERSUS MAXIMUM JUMPING

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AIM: To compare, in a prospective clinical study, condylar changes during stepwise mandibular advancement and mandibular maximum jumping.
SUBJECTS AND METHOD: The headgear activator group (HGA-S) had stepwise advancement (n = 24, mean age = 11.9 ± 1.2 years) for 4 mm every 3 months with individualised bite opening following the condylar translatory pathway, whilst the HGA-M group (n = 31, mean age = 11.2 ± 1.5 years) had maximum jumping to edge-to-edge with 6 mm interincisal opening. Active treatment was 12 months (T0-T12) for the HGA-S group and 6 months (T0-T6) for the HGA-M group followed by 6 months (T6-T12) of reduced appliance wear and headgear cessation. Superior and posterior condylar changes were analysed from full mouth opening lateral cephalograms (Pancherz and Hägg, 1985) taken at the start (T0) and 6 (T6) and 12 (T12) months after treatment. The results were adjusted to the same observation lengths. Growth changes were obtained from the untreated control group, i.e. HGA-M group (10.3 ± 2.4 years) before treatment.
RESULTS: There was similar sagittal condylar treatment effect with both devices during the initial (T0-T6), late (T6-T12) and total treatment (T0-T12) phases. There was no statistically significant

vertical condylar effect with HGA-M during either the initial (T0-T6) or late (T6-T12) phases, whereas HGA-S resulted in a statistically significant effect during both phases.
CONCLUSION: Both mandibular maximum jumping and stepwise advancement resulted in a sagittal condylar effect. However, there was a vertical condylar effect only with mandibular stepwise advancement. This indicates that the amount and frequency of bite jumping seem to be decisive factors for treatment effects on the condyles.

313 TRANSPALATAL DISTRACTION FOR RAPID PALATAL EXPANSION
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AIM: Rapid palatal expansion (RPE) is utilized for treatment of a skeletal crossbite and as an adjunct for maxillary protraction. Employing tooth-borne appliances, a healthy and periodontically intact dentition is of the utmost importance. However, not all patients fulfil this requirement. In such cases, bone-borne palatal distraction devices are of advantage.
SUBJECTS AND METHOD: In five patients with maxillary transversal and sagittal deficiency, transpalatal distractors (TPD; Surgitech, Brugge, Belgium) were inserted. Anterior and posterior transversal arch diameters as well as the occlusal relationship between upper and lower arches were recorded before and after distraction.
RESULTS: TPDs proved to be a reliable maxillary expansion device for patients with missing teeth or predisposition for root resorption. Mean transversal expansions of 7.6 mm in the anterior and 6.1 mm in the posterior region were found. The crossbite was successfully corrected in all patients.
CONCLUSIONS: In patients with insufficient teeth for anchorage, the TPD is a viable alternative to tooth-borne appliances. The achieved maxillary expansion was comparable with conventional RPE. Buccal tipping of anchorage teeth as well as adverse periodontal reactions and root resorption can be totally avoided.

314 THE EFFECT OF GUSUIBU ON BONE REMODELLING
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AIM: Traditional Chinese medicines have been used in the Chinese population for the treatment of bone disease and to promote bone healing for several thousand years. Pan *et al.* (1992) examined the local effect of a Chinese herb, Gusuibu, on increasing the rate of orthodontic tooth movement in guinea pigs and rabbits. However, no information is known about the systemic effect of Gusuibu on bone. The aim of this investigation was to assess the systemic effect of Gusuibu consumption on bone histomorphology.
MATERIALS AND METHOD: Twenty-eight-week-old male BALB/c mice were divided into two groups. In the control group, 10 mice were fed daily with distilled water, while in the Gusuibu group, 10 mice were fed daily with distilled water mixed with Gusuibu extract. The mice were kept for five weeks and were then killed. Using micro-computed tomography, 20 micro-tomographic slices with an increment of 0.25 mm were acquired to cover the proximal end of the left tibia of each mouse. Quantitative morphometry of the bone structure was performed.
RESULTS: Consumption of Gusuibu extract increased the bone volume/tissue volume ratio by 6.45 per cent. Trabecular bone increased by 10 per cent, implying that the bone density was increased.
CONCLUSION: Gusuibu extract taken orally increases bone density and triggers bone remodelling.

315 CEPHALOMETRIC NORMS OF CHINESE: PANCHERZ'S ANALYSIS
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AIM: To establish cephalometric norms for Chinese using the analysis of Pancherz (1982), and to compare them with those of Caucasians.
MATERIALS AND METHOD: Lateral cephalometric radiographs taken in natural head posture of a

random sample of 200 male and 205 female 12-year-old southern Chinese together with 43 male and 43 female 12-year-old British Caucasian children in Hong Kong. The radiographs were digitised twice using the CASSOS program.
RESULTS: In males with Pancherz's sagittal analysis, the position of the maxillary base, mandibular base, mandibular length and molar relationship were significantly larger in Caucasians than in Chinese, while the maxillary central incisor related to point A and mandibular central incisor related to pogonion were significantly larger in Chinese than in Caucasians. In males with Pancherz's vertical analysis, the overbite was significantly larger in Caucasians than in Chinese while the position of the mandibular central incisor, maxillary and mandibular permanent first molars, nasal plane angle, mandibular plane angle and mandibular occlusal plane angle were significantly larger in Chinese than in Caucasians. For females using Pancherz's sagittal analysis, the position of the maxillary and mandibular base, maxillary permanent first molar, mandibular length, overjet, jaw relationship and molar relationship were significantly larger in Caucasians than in Chinese, but the maxillary central incisor related to point A and the mandibular central incisor relate to pogonion were significantly larger in Chinese than in Caucasians. In females using Pancherz's vertical analysis, overbite was significantly larger in Caucasians than in Chinese, but lower face height, the position of the mandibular central incisor, the maxillary and mandibular permanent first molars, nasal plane angle and mandibular plane angle were significantly larger in Chinese than in Caucasians.
CONCLUSION: There are significant differences between Chinese and Caucasian using Pancherz's analysis.

316 CEPHALOMETRIC NORMS OF CHINESE: McNAMARA'S ANALYSIS
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AIM: To establish cephalometric norms in Chinese using McNamara's (1984) analysis, and to compare them with those of Caucasians.
MATERIALS AND METHOD: Lateral cephalometric radiographs taken in natural head posture of a random sample of 200 male and 205 female 12-year-old southern Chinese together with 43 male and 43 female 12-year-old British Caucasian children in Hong Kong. The radiographs were digitised twice with the CASSOS program.
RESULTS: In males, the effective midface height, facial axis angle and pogonion to nasion perpendicular were significantly larger in Caucasians than in Chinese, while SNA, maxillomandibular difference, mandibular plane angle, upper incisor to point A and lower incisor to A-Po line were significantly larger in Chinese males than in Caucasian males. In females, the effective midface height and facial axis angle were significantly larger in Caucasian than in Chinese, while the maxillomandibular difference, lower anterior face height, mandibular plane angle, upper incisor to point A and lower incisor to A-Po line were significantly larger in Chinese females than in Caucasian females.
CONCLUSION: There are significant differences between Caucasian and Chinese cephalometric norms using McNamara's analysis.

317 COMPARISON OF EXTRACTION VERSUS NON-EXTRACTION ORTHODONTIC TREATMENT OUTCOMES FOR BORDERLINE CHINESE PATIENTS
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AIM: To compare the outcomes of extraction and non-extraction fixed appliance therapy in a representative sample of borderline patients of Chinese ethnicity.
MATERIALS AND METHOD: The pre-treatment records of 215 patients were evaluated retrospectively by each of five associate professors. On the basis of the judges' independent decisions, each patient was classified as 'extraction', 'non-extraction', or 'borderline'. Patients were classified as borderline if the majority of judges assigned them to that category, or if there was clear

disagreement among the judges' decisions for and against extraction. The distribution of assignments was: extraction 91, non-extraction 38, and borderline 71. One year later, the end-of-treatment records of each of the 39 borderline patients for whom orthodontic treatment had been completed were re-examined. Sixteen had been treated non-extraction, 14 with extraction of four first premolars, and nine with extraction of four second premolars. The end-of-treatment records were scored by five judges for quality of tooth alignment, overbite, overjet, midline symmetry, lateral occlusion, and facial profile on an ascending scale from 1 to 5.
RESULTS: The only statistically significant difference between the extraction and non-extraction groups was for facial profile. For that variable, the extraction group scored 4.47 ± 0.258, while the non-extraction group scored 4.19 ± 0.260 (P = 0.001 by ranked sum test).
CONCLUSION: In this sample of borderline orthodontic patients, the clinicians had a statistically significant preference for the facial profiles of the extraction patients but no statistically significant preferences for the outcome of extraction or non-extraction treatment as regards tooth alignment, overbite, overjet, midline symmetry, or lateral occlusion.

318 MEASUREMENTS OF MAXIMUM AND SWALLOWING TONGUE PRESSURES ON THE ANTERIOR REGION OF THE PALATE

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AIM: The function of perioral muscles is indispensable to the establishment of occlusion and its continuation. Although it is said that the pressure balance of the perioral muscles are important, an established measuring method does not exist. The aim of this presentation is to report a new measurement device for assessing tongue pressure.
MATERIALS AND METHOD: The measurement device was included in a super-miniature sensor for the purpose of measuring the whole of the pressure in the area anterior vault of the palate. The subjects consisted of a control group with a normal occlusion (Nm; 10 males, 10 females), a maxillary protrusion group (Mx; five males, five females) and a mandibular prognathism group (Md; five males, five females).
RESULTS: The maximum average tongue pressure was: 74.2 kPa in the Mx group, 102.2 kPa in the Md group and 96.5 kPa in the Nm group. The maximal pressure of the Mx group was significantly lower than those of the Md and Nm groups. During swallowing tongue pressure was, on average, 30.3 kPa in the Mx group and 28.8 kPa the in Md group, showing approximately the same value. Although there was no significant difference, it was lower than the value of the Nm group, i.e. 42.3 kPa. In the Mx group, tongue posture was distant from the anterior part of palate; the pressures were lowest.
CONCLUSIONS: Maximum tongue pressure and tongue pressure during swallowing differ according to the type of occlusion.

**Author(s) report(s) financial interest with presented subject or research results