ABSTRACTS
OF LECTURES

(Poster presentations will appear in the October issue of the Journal)

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1 THE RESPONSE OF THE CONDYLE AND THE GLENOID FOSSA TO LENGTHENING OF THE MANDIBLE BY DISTRACTION OSTEOGENESIS IN PRIMATES

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AIMS: The purpose of this study was to investigate the response of the condyle and the glenoid fossa to mandibular advancement using the principles of distraction osteogenesis and bilateral sagittal split ramus osteotomy.
MATERIALS AND METHOD: Two adult female *Cynomolgus* primates were used in this investigation. Metallic markers were placed in the cranial base, maxilla and mandible, and cephalometric radiographs were taken. Bilateral sagittal split osteotomies were made between the ascending ramus of the mandible and the second premolar teeth, and the dental osseosegment was completely mobilized. A distraction device was fabricated with a Glen-Ross screw soldered between two orthopaedic bone plates. The bone plates were adjusted so that the Glen-Ross screw was at the same level as the mandibular occlusal plane. The posterior part of the screw was located 2 to 3 mm, and the anterior part 4 to 5 mm, from the gingival tissues to prevent the lateral displacement of the mandibular condyles. The bone plates were fixed by orthopaedic screws to both right and left mandibular segments. One week post-operatively both distraction plates were opened four-quarter turns every day until the mandible was advanced by 10 mm. Cephalometric radiographs were taken at 2, 4 and 6 weeks post-completion of the mandibular orthopaedic advancement. At 7 weeks, both distraction plates were removed and at 1, 3 and 5 weeks later, cephalometric radiographs were taken and study models fabricated. The animals were then sacrificed, and the temporomandibular joints were prepared by routine histological methods for examination by light microscopy.
RESULTS AND CONCLUSIONS: Histological analysis indicated that the condyle and the glenoid fossa exhibited reversal and oppositional lines. These findings indicate that during the experimental period there was resorption of the post-glenoid tubercule and that during the post-retention period repair occurred.

2 THE AESTHETIC COMPONENT OF IOTN AS A MEASURE FOR FACIAL ATTRACTIVENESS

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AIM: The IOTN is widely used as a measure for treatment need. The index has two components; a Dental Health Component (DHC) and an Aesthetic Component (AC). One of the shortcomings of this index, however, is that it measures only dental attractiveness and not facial attractiveness. The aim of this study was to test whether the AC of the IOTN is representative for facial attractiveness.
SUBJECTS AND METHOD: Facial attractiveness of two groups of children (n = 80, age 11 to 13 years; n = 80, age 14 to 16 years) was rated at two different ages on facial photographs using the facial attractiveness scale of Peerlings *et al.* (1995). Furthermore two independent scorings of the AC of the IOTN were undertaken: one of the dental cast and one of the comparable intra-oral colour photograph. Pearson's correlation coefficients were calculated to assess the correlation between the scores for dental and facial attractiveness.
RESULTS: A significant correlation was found between the AC of the IOTN and the facial attractiveness score. The highest correlation existed with the AC as measured on the colour photograph ($r = .52$, $P < 0.01$). After categorizing the AC according to treatment need, only in moderate and severe malocclusions could a significant correlation be found with the facial attractiveness score ($r = .48$, $P < 0.01$). When ranking the malocclusion using the DHC of the IOTN, it was found that the occlusal traits within grade 3 to 5, which are associated with overjet and crowding, show a significant correlation with facial attractiveness.
CONCLUSION: The Aesthetic Component of the IOTN is a representative measurement for facial attractiveness, but only in moderate and severe malocclusions.

Peerlings R H J, Kuijpers-Jagtman A M, Hoeksma J B 1995 European Journal of Orthodontics 17: 101–109

3 CERVICAL SPINE ABNORMALITIES IN SYNDROMIC CRANIOSYNOSTOSIS

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AIM: The aim of this study was to assess the incidence and pattern of cervical spine abnormalities in individuals with Crouzon, Pfeiffer or Saethre-Chotzen syndromes. Cervical spine abnormalities have been noted in previous reports, but there is little longitudinal data available concerning the incidence or progression of abnormalities in a large group of patients.
METHOD: The cervical spine radiographs of individuals with a confirmed diagnosis of Crouzon (n = 39), Pfeiffer (n = 22) or Saethre-Chotzen (n = 20) syndromes were reviewed by members of the craniofacial team, and a paediatric radiologist with expertise in skeletal dysplasias.
RESULTS: Evidence of cervical spine fusions were present in 20 per cent of Crouzon cases, 77 per cent of Pfeiffer cases and 45 per cent of Saethre-Chotzen cases. In Saethre-Chotzen children under 2 years of age, only 1 in 18 cases showed evidence of fusion. In marked contrast, after the age of 2, 10 out of the 11 cases had evidence of fusion. In all three syndromes C2 C3 was most commonly affected, with C5–C6 also equally affected in Crouzon syndrome. Analysis of sequential radiographs showed evidence of progression in 28 per cent of Crouzon cases, 73 per cent of Pfeiffer cases and 77 per cent of Saethre-Chotzen cases.

Radiological abnormalities seen, apart from fusions, included 'butterfly vertebrae', 'hemi-vertebrae' and hypoplasia of the neural arch.
CONCLUSIONS: These results show that the incidence of cervical spine abnormalities is greater than in the general population. The incidence of fusions in this series was lower than previously reported for Crouzon syndrome (Proudman *et al.*, 1994) but higher for Pfeiffer syndrome (Moore *et al.*, 1995) and may reflect a change from a clinical to a genetic diagnosis. The clinical significance of these findings remains unclear. It is possible that progressive cervical spine fusion may affect head posture which could in turn affect growth of the craniofacial complex.

Proudman *et al.* 1994 Noncraniofacial manifestations of Crouzon's disease. Journal of Craniofacial Surgery 5: 218–222
Moore *et al.* 1995 Spinal anomalies in Pfeiffer syndrome. Cleft Palate Craniofacial Journal 32: 251–254

4 EARLY DETECTION OF SURGICAL OUTCOME IN CLEFT LIP AND PALATE SUBJECTS

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AIM: This study aimed to use dental occlusal features of subjects born with a unilateral cleft lip and palate (UCLP) to develop an index for assessing surgical outcome in UCLP children aged 5 years.
MATERIALS AND METHOD: The Goslon scoring system (Mars *et al.*, 1987) was used on longitudinal study models taken at 5 and 10 years of age of 27 UCLP subjects. The data from this initial study enabled the development of a 5 year olds' index. A further 60 randomly selected models of 5–6 year old UCLP subjects were obtained. The corresponding longitudinal models at 16–18 years of 54 of this latter sample were also acquired. These subjects had undergone orthodontic treatment but not orthognathic surgery.
RESULTS: There was good intra-examiner agreement when assessing the 5 and 10 year olds' models using the Goslon Yardstick. Inter-examiner agreement for both age groups was, at worst, moderate. Between 70–93 per cent (depending on examiner) of 5 year olds' models were demonstrated to have either remained in the same category or deteriorated by 10 years of age. Consensus agreement produced a five-category index of outcome for assessing 5 year olds' study models. The new index comprised two representative models in each category. Its reproducibility, reliability and predictive validity was then investigated. The intra-examiner agreement using the new Index was excellent. The inter-examiner agreement was shown to be good. The need for osteotomy amongst the 16–18 year olds' models was assessed. Between 13–15 per cent (depending on examiner) of 5 year olds' models were scored in the groups likely to need orthognathic surgery. In the corresponding 16–18 year olds' models 9 per cent were assessed as likely to benefit from an osteotomy. It was not possible, however, to predict, on an individual basis, future growth from models at age 5.
CONCLUSIONS: This study has provided a reliable and reproducible index for assessing the outcome of surgery in UCLP subjects earlier than indices already available.

Mars M, Plint D A, Houston W J B, Bergland O, Semb G 1987 The Goslon Yardstick: A new system of assessing dental arch relationships in children with unilateral clefts of the lip and palate. Cleft Palate Journal 24: 314–322

5 TRANSVERSE INTERARCH DISCREPANCY IN EARLY CLASS II DIVISION 1 MALOCCLUSION

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AIM: To analyse the relationship between transverse interarch discrepancy and mandibular retrusion in subjects with Class II division 1 malocclusions during the mixed dentition.
SUBJECTS AND METHODS: Posterior Transverse Interarch Discrepancy (PTID) measured as the difference between maxillary and mandibular intermolar widths was assessed in a sample of 60 Class II division 1 subjects (26 boys, 34 girls, mean age 10.25 ± 1.54 years) in the mixed dentition. Two groups derived from the analysis of PTID: Class II group A (30 subjects: 15 boys, 15 girls, mean age 10.1 ± 1.34 years) with PTID, and Class II group B (30 subjects: 11 boys, 19 girls, mean age 10.41 ± 1.72 years) without PTID (PTID = zero). A sample of 30 subjects with ideal occlusion in the mixed dentition (12 boys and 18 girls, mean age 10.1 ± 1.89 years) was used as a control group. Cephalometric and dental cast analysis was performed for all examined groups. The results were analysed by means of non-parametric statistics (Kruskal–Wallis and Mann–Whitney tests).
RESULTS: In Group A, PTID was due to a significantly narrower maxillary arch when compared with the control group ($P < 0.001$). Group A also showed mandibular retrusion associated with a posteriorly displaced mandible of normal size (functional mandibular retrusion). Group B exhibited mandibular retrusion due to a micrognathic mandible (anatomical mandibular retrusion), as revealed by the significantly smaller mandibular total and body length when compared both with Group A and the control group ($P < 0.01$).
CONCLUSIONS: This study confirmed the role of the transverse component of occlusion in the control of maxillo-mandibular skeletal relationships. Expansion of the upper arch appears to be indicated as a preliminary interceptive treatment in Class II division 1 malocclusions with transverse discrepancy, before forward repositioning of the mandible may be stimulated with functional appliances.

6 TOOTH MOVEMENT: EFFECTS OF FORCE DELIVERY FROM NICKEL TITANIUM ARCHWIRES

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Investigation of glycosaminoglycans (GAG) in gingival crevicular fluid (GCF) has demonstrated increased amounts of the GAG chondroitin sulphate (CS) in GCF associated with particular orthodontic tooth movements (Samuels *et al.,* 1993). The effects of NiTi wires on periodontal tissues in early movement are unknown.

AIM: This study related changes in flow and CS content of GCF to early tooth movements by pre-adjusted Edgewise appliances (FA) with NiTi wires.

METHODS: GCF samples were collected for 15 minutes from the disto-buccal aspect of one maxillary canine of 33 patients treated with FA and NiTi wires, on 4 visits within the first 22 weeks of treatment, and 1 sample taken before FA placement. The quantity of CS was determined by electrophoretic separation and densitometric scanning of the GAG in the sample. Reflex metrography assessed, from dental casts, the type of tooth movement produced over this period.

RESULTS: CS content (mean $\pm$ SEM) increased ($P < 0.001$), rising from 2.2 ± 1.0 ng 15 minutes pre-treatment, to a maximum of 70 ± 21 ng 15 minutes 10 weeks into treatment and thereafter remained relatively constant. Those teeth categorised as predominantly showing root tipping or bodily or vertical movements, had increased CS levels by 10 weeks ($P < 0.01$). However teeth showing distal crown movement, (mean $\pm$ SEM) 11.3 ± 2.1 degrees showed no significant increase in CS levels.

CONCLUSIONS: These data suggest that force delivery by NiTi archwires to pre-adjusted brackets produced more periodontal tissue perturbation reflected in GCF and GAG when the principal orthodontic change affects root position.

Samuels R A H, Pender N, Last K S 1993 The effects of orthodontic tooth movement on the glycosaminoglycan components of gingival crevicular fluid. Journal of Clinical Periodontology 20: 371–377

7 TRANSCRIPTION OF FACTORS JUN AND FOS AS ELEMENTS OF THE MECHANOTRANSDUCTION PATHWAY N PERIODONTAL LIGAMENT FIBROBLASTS

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AIM: The aim of this study was to examine the involvement of the immediate-early gene products Jun and Fos in the response of human periodontal ligament (PDL) fibroblasts to mechanical stretching. Bearing in mind that the majority of extracellular stimuli are translated into changes in gene expression patterns by reversible phosphorylation events of nuclear proteins such as the aforementioned transcription factors, the activation of specific protein kinases targeting Jun and Fos after mechanical stimulation of PDL fibroblasts were investigated.

MATERIAL: PDL fibroblasts were isolated from healthy individuals and cultured in petri dishes with flexible bottoms under previously established conditions.

METHOD: Cultured PDL fibroblasts were subjected to mechanical stretching on a convex template with a weight applied on top and producing a -2.5 per cent degree of stretch. After 20 minutes (immediate–early response) extracts were prepared from stretched and control cultures and their kinase activity against Jun and Fos (served as immobilized substrates) was tested by means of an elaborated in-gel kinase assay.

RESULTS: Analysis revealed that several protein serine/threonine kinases, with apparent molecular masses in the range of characterized Jun/Fos targeting enzymes, were induced in mechanically-stretched PDL fibroblasts and augmented the basal level phosphorylation of both substrates.

CONCLUSIONS: The initial step in the response of PDL fibroblasts to mechanical stretching seems to involve post-translation modification (phosphorylation) of pre-existing Jun and Fos molecules, a class of transcription factors implicated in various aspects of cellular growth and differentiation. Since phosphorylation of these proteins following activation of intracellular signal transduction cascades is known to elicit their DNA-binding/transcription properties, it is postulated that mechanical stretching leads to genetic reprogramming via potentiation of Jun and Fos.

8 INTERCEPTIVE ORTHODONTICS

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(KEYNOTE ADDRESS)

Interceptive orthodontics covers treatment carried out prior to the development of the full adult dentition. The intention is to prevent the establishment of a malocclusion, either in part or totally and provide a more normal foundation from which further development can proceed.

In those cases exhibiting an increased overjet, it is also important to bring proclined upper incisors back to within the protection of the lip musculature as soon as possible, to avoid the significant risk of fracture.

Children in the age group of 5–10 years, usually seen during interceptive therapy, are very pleasant to work with and in general make very rewarding patients. Less pressure from school work often allows far easier appointment scheduling. Interceptive therapy is carried out passively or with simple appliances needing little supervision and should be time- and cost-effective for all concerned.

Procedures which will be repeated later on when the permanent dentition is fully erupted, unnecessarily complex procedures, or those which will prolong the total time in treatment, should be avoided during the interceptive stage.

9 FLUOROSCOPIC/CEPHALOMETRIC AIRWAY ANALYSIS IN OBSTRUCTIVE SLEEP APNOEA (OSA) SUBJECTS DURING MANDIBULAR PROTRUSION

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AIM: To investigate the response of the oro-pharyngeal airway to mandibular protrusion in subjects with obstructive sleep apnoea (OSA), in order to determine their likely response to treatment with a mandibular advancement splint.
SUBJECTS: Twenty dentate, adult males were studied, in whom the diagnosis of OSA had been confirmed by polysomnography. All had been unable to tolerate treatment with nasal continuous positive airway pressure (CPAP) and had been referred to assess their suitability for mandibular advancement splints.
METHOD: With the subject in the supine position, cine-fluoroscopic examination of the face and upper airway was undertaken. Each sequence lasted less that five seconds with a film exposure speed of 4 frames per second. The dimensions of the post-palatal and post-lingual airways and the amount of protrusion were recorded by sequential frame analysis of the completed film. Prior to this assessment conventional lateral cephalometric radiographs of the subjects were analyzed with respect to skeletal pattern, mandibular length, hyoid position, soft palate, tongue and airway dimensions. Specific combinations of these abnormalities formed the basis for predicting whether or not the airway would respond to mandibular protrusion.
RESULTS: There was a wide variation of individual response. Close agreement was found between the cephalometric predictions and the fluoroscopic findings. A good response was seen where a reduced lower face height, low Maxillo–Mandibular (MM) planes angle and relatively normal mandibular body length and position of the hyoid were accompanied by normal tongue and soft palate dimensions. Provided that the skeletal elements were favourable, subjects with excessive palatal tissue also responded. Where the lower face height and MM planes angle were increased, the mandibular body short and the hyoid position low, a positive response was not apparent even in the absence of grossly enlarged soft palate to tongue volumes.
CONCLUSIONS: In selected patients, advancement of the lower jaw by a mandibular repositioning splint may be the optimal therapy. Where both skeletal and soft tissue factors are adverse, such measures are unlikely to be of benefit.

10 TREATMENT OF SNORING AND SLEEP APNOEA PATIENTS WITH MAGNETIC OCCLUSAL SPLINTS

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AIM: The aim of this study was to evaluate a new dental magnetic appliance for treatment of patients with snoring and sleep apnoea.
SUBJECTS AND METHOD: Twenty men (mean age 55.3 years, SD 11.35), with a history of disturbed sleep, characterised by heavy snoring and recurrent sleep apnoea, were consecutively referred from the Department of Otorhinolaryngology, Central Hospital, Kristianstad, Sweden. The appliance consisted of a maxillary and a mandibular occlusal acrylic splint. In each splint 4 cylindrical neodymium–iron–boron magnets were inserted and orientated to produce intermaxillary forces that pulled the mandible forward. After a treatment period of 3 months questionnaires were used for registration of the patients' subjective rating of day-time sleepiness and their close relatives' opinions about the snoring. The treatment effects on the temporomandibular joint were evaluated according to Helkimo's anamnestic and clinical dysfunctional indices and nightly screening pulsoximetry was performed before and after 3 months of treatment. Furthermore, the treatment effects on the craniofacial skeletal and upper pharyngeal soft tissue profiles were analysed cephalometrically.
RESULTS: Fourteen of the 20 patients reported that the day-time sleepiness had been reduced and 18 of 20 close relatives reported that the magnetic splints had eliminated the snoring. The pulsoximetry analysis showed an improvement of oxygen saturation in 10 of 20 patients. Treatment had no effect on the temporomandibular joint status. During use of the appliance the mandible was rotated backwards and the backward rotation mostly eliminated the sagittal forward movement of the mandible. There was no significant influence on the hyoid bone position or on the upper pharyngeal soft tissue airway space when the appliance was inserted.

11 CONDYLAR UNLOADING AND GROWTH OF THE MANDIBLE IN SUBJECTS WITH CLASS II DIVISION 1 MALOCCLUSIONS

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AIM: The mode of action of functional appliances in treating patients with Class II division 1 malocclusions presenting mandibular retrusion, is still controversial. A common denominator of all functional appliances is mandibular propulsion, which has always been considered to be essential for the success of treatment. However, it has also been reported in the literature that mandibular propulsion is not necessary and whatever effect is observed is provided

through unloading of the condyle. The aim of the present study was to investigate the above concept by comparing results obtained through the application of an appliance which simply unloads the condyle but does not create any mandibular propulsion, with those obtained by an activator.
SUBJECTS AND METHOD: Three groups of children were studied. A: Eighteen children (10 girls and 8 boys) aged 9 to 11 years, selected on the basis of having a severe skeletal Class II division 1 malocclusion attributed mainly to mandibular retrusion as revealed by the lateral cephalographs. In this sample an upper removable appliance (palatal plate) covering all the upper teeth and opening the bite about 3 mm was delivered. The appliance was worn for 14 hours per day. B: Fifteen children matched for age, sex and skeletal appearance with group A, were selected. A simple activator was worn for 14 hours per day. C: Fifteen children matched for age, sex and skeletal appearance to the above groups, were used as controls. These did not receive any treatment. From all three groups cephalograms were taken initially and one year later. Conventional linear and angular cephalometric measurements were used in order to compare the changes observed. Statistical analysis was applied for further evaluation.
RESULTS: The findings show that: 1. The group wearing the palatal appliance did not exhibit any improvement regarding mandibular size or position. 2. The activator group presented significant improvement. 3. The rate of mandibular growth was more in sample B.
CONCLUSIONS: The present investigation leads to the conclusion that condylar unloading alone does not seem to affect or promote mandibular growth.

12 ATTRACTIVE MAGNETS FOR ORTHODONTIC EXTRUSION OF CROWN-ROOT FRACTURED TEETH

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INTRODUCTION: A subgingival crown-root fracture presents the clinician with a difficult restorative problem to reach the fracture line, and is complicated by the need to maintain the periodontal tissues in good health. Usually the treatment options have been extrusion of the remaining root with a conventional fixed orthodontic appliance, or surgical intra-alveolar transplantation of the root.
AIM: To demonstrate and evaluate an alternative new method of orthodontic extrusion with attractive magnets for rapid extrusion of remaining roots after crown-root fractured teeth.
MATERIALS AND METHODS: One or two neodymium-iron-boron magnets were attached to the remaining root(s) and a second, larger neodymium-iron-boron magnet was incorporated in a removable appliance.
RESULTS: The roots were extruded 2–3 mm with a force range from 0.5 to 2.4 N during a treatment period of 9–11 weeks. Good force control at short distances, no friction and no material fatigue of the permanent rare earth magnets resulted in successful rapid extrusion. No evidence of soft tissue dehiscence or root resorption was found.

13 LONG-TERM EFFECTS OF ORTHODONTIC MAGNETS ON HUMAN BUCCAL MUCOSA—A CLINICAL AND IMMUNOHISTOCHEMICAL STUDY

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AIM: The aim of this intra-individual study was to examine buccal mucosa clinically and immunohistochemically after long-term exposure to orthodontic magnets.
SUBJECTS AND METHOD: In 8 subjects (17.8–42.2 years of age), a magnet and a demagnetised magnet of parylene coated neodymium-iron-boron ($3 \times 3 \times 1$ mm) were bonded with composite buccally on maxillary premolars alternately on the right and left side. The pole face was thereby in close contact with the buccal mucosa for an experimental period of 9 months. The buccal mucosa was clinically examined and photographed. Three punch biopsies (6 mm diameter) were taken from each subject at the site of contact with the magnet (test), in contact with the demagnetised magnet (control) and also at a site on the control side without contact with the demagnetised magnet (normal). The biopsies were snap-frozen for histological and immunohistochemical investigation using antibodies to HLADR, CD45RO, CD45RB, ELAM1 ICAM1 and mast cell tryptase.
RESULTS: Clinically, the buccal mucosa close to the magnets showed normal and identical features before, during and after the experimental period. In 4 of the 8 subjects a thicker epithelium was found (ranging from $\times 1.4$–2.3) at test and control sites than at normal sites. There was no difference in thickness between test and control sites and there were no signs of increased keratinisation or other surface abnormalities. Compared with normal sites, all test and control sites showed slightly increased ELAM1/ICAM1 vascular staining and HLADR-staining, and there was no difference between control and test sites. In 3 subjects small infilatres of CD45RO/CD45RB lymphocytic cells were detected both in control and in test sites. No difference in the number of tryptase$^+$ cells between normal, control and test sites could be documented.
CONCLUSION: Long-term exposure to static magnetic

fields did not result in any harmful effects on the buccal mucosa in humans.

14 RESPONSE OF PERIODONTAL FIBROBLASTS TO MECHANICAL STIMULATION WITH MAGNETIC IMMUNOMICROSPHERES (MIMS)

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AIMS: Periodontal ligament (PDL) fibroblasts appear to modulate their activity in response to mechanical orthodontic forces. The systematic characterization of the molecular and cellular transduction mechanisms underlying mechanically induced metabolic modulation is, as yet, not completely clear. However, there is strong evidence that integrins and the cytoskeleton play an important role in signal transduction. The objective of this investigation was to develop a new *in vitro* experimental system for mechanical stimulation of PDL fibroblasts, which permits a systematic investigation of the cellular response to specific mechanical strain on different integrin receptors.

MATERIALS AND METHOD: For all experiments human PDL fibroblasts from an extracted premolar were used. Cells were incubated under standard culture conditions until the second passage. For mechanical stimulation specific magnetic immunospheres (MIMS) were fabricated which were conjugated with antibodies against α_2- (P1E6), α_3-(P1B5) and β_1-integrin (P4C10). Cells of the second passage ($\approx 6.5 \times 10^5$ cells per dish) were incubated with MIMS for 30 minutes at 37°C. Subsequently cells were washed, trypsinized and the percentage of magnetically labelled cells was detected with a specific magnetocytometer (Winoto-Morbach *et al.*, 1994). Shedding between cells and MIMS was examined with the same method after 18, 24, 48 and 72 hours of incubation. Toxicity of the MIMS-antibody-complexes was measured after 18 and 24 hours by trypan blue exclusion. Cells were mechanically stressed by an inhomogeneous magnetic field with two specific permanent magnets. After RNA-extraction, mRNA-levels for different collagen types were determined.

RESULTS: Incubation with MIMS-antibody-complexes did not show any significant degree of cell death (6.9 to 8.4 per cent) in experimental cultures when compared with controls (8.4 to 10.0 per cent). With the magnetocytometer 46 and 98 per cent of the cells could be detected, which means, that 98 per cent of the cells were conjugated with a MIMS-antibody complex. The best results were achieved using 1 mg MIMS and 2 µl anti-integrin-antibody in 2 ml medium free of serum. No significant differences were found between α_2- α_3- and β_1-integrins. In addition the time-dependent binding of MIMS-antibody-complexes to PDL fibroblasts showed no significant differences after the various incubation intervals. Mechanical stimulation of the cells through different integrin receptors showed, in experimental cultures, significant differences in mRNA levels for different collagen types when compared with controls.

CONCLUSIONS: This new *in vitro* system is able to provide further information in the field of signal transduction mechanisms in orthodontic tooth movement. With that knowledge the clinical orthodontic tissue reaction to different orthodontic mechanics may be more predictable than in the past.

15 ORTHODONTIC BONDING TO DIFFERENT TYPES OF AMALGAM: LABORATORY AND CLINICAL FINDINGS

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AIM: To evaluate the tensile bond strength of orthodontic brackets bonded to three different types of silver amalgam, using different surface treatments and intermediate resins

MATERIALS AND METHOD: For the laboratory study, flat rectangular tabs were prepared from three different types of amalgam (lathe-cut, admixed, spherical). The amalgam surfaces were sandblasted with either 50 or 90 µm aluminum oxide. Mandibular lower incisor brackets (n = 270) were bonded on sandblasted amalgam tabs using a conventional orthodontic resin (Concise) after application of the intermediate resins AllBond 2 Primers A + B (AB2), or the 4-meta products Amalgambond (A) and Reliance Metal Primer (MP). All specimens were stored in a water bath at 37°C for 24 hours before being thermocycled 1,000 times from 5 to 55°C. The bond strength of Concise to etched enamel was used as a control. Bond failure sites were classified by a modified Adhesive Remnant Index (ARI) system.

RESULTS: In the laboratory study the tensile bond strengths in the experimental groups ranged between 3–10.9 MPa. Significantly higher bond strengths were measured when bonding to the spherical amalgam compared with the admixed or lathe-cuts. Bond failures typically occurred at the amalgam/adhesive interface. Mean bond strengths up to 8 MPa were measured with AB2 application and the bond strengths were even higher when sandblasted amalgam was coupled with an intermediate application of A or MP, albeit lower than that of Concise, to etched enamel. The effect of abrasive particle size on bond strength was not significant (ANOVA, Duncan's multiple range test, $P < 0.05$).

The clinical trials, to verify the validity of the laboratory findings, proved to be satisfactory. One hundred and forty three molar attachments were bonded on amalgam surfaces in 76 patients and only 12 failures were recorded over a three-year period.

CONCLUSION: Using new techniques it is now possible to successfully bond orthodontic attachments to different types of dental amalgam with excellent clinical results.

16 MOLAR DISTALIZATION WITH THE PENDULUM APPLIANCE: CLINICAL AND RADIOLOGICAL EVALUATION

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AIM: Various intra-arch techniques have been introduced during the last decade to distalize the upper first molars. Clinical trials describe the most simple and effective intra-oral device which requires minimal patient co-operation.
SUBJECTS AND METHOD: In this study, the Pendulum Appliance, recently described by Hilgers, was used on 13 patients (mean age 11.1 ± 1.9 years) with anchorage on the palatal vault and on the teeth in the lateral segment. Clinically all patients presented a dental Class II relationship with moderate space deficiency in the upper arch. No extractions were performed and the Pendulum Appliance was worn until a Class I molar relationship was obtained. Sagittal and vertical dental movements as well as angular changes of the maxillary molars, second premolars and incisors were evaluated according to Björk's superimposition method on the lateral cephalometric headfilms taken before and after treatment. Palatal plane/mandibular plane angle, y-axis angle as well as SNA angle were evaluated. Mean treatment time was 16.6 (± 7) weeks, the distalization rate of the molars was 0.94 mm (± 0.63) per month.
CONCLUSIONS: The Pendulum Appliance is very effective for maxillary molar distalization and seems promising in clinical application, particularly for non-co-operative patients. The distalization of upper molars is accompanied by bimolar intrusion, the appliance does not create dental or skeletal bite opening, the incisor anchorage loss is minimal, but distal tipping of the molars is an important factor and should be taken into consideration.

17 CRANIOFACIAL MODIFICATIONS IN CHILDREN WITH SNORING AND OBSTRUCTIVE SLEEP APNOEA

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In children, habitual snoring and Obstructive Sleep Apnoea (OSA) are frequently related to upper airway (UA) obstruction and associated with enlarged adenoids and tonsils. It has already been noted that adult patients and chronic snorers often have craniofacial and cephalometric abnormalities. The reappearance of snoring in teenagers, after adenoid/tonsillectomy at prepubertal age, has been suggested to be a consequence of possible craniofacial bone modifications probably provoked by the early onset of UA obstructions.
AIM: The aim of the study was to verify the presence of early craniofacial and cephalometric modifications in young children with a long history of habitual snoring.
SUBJECTS: A sample of 26 children, 13 males (mean age 54 months, range 36–103) referred to the Sleep Center for heavy and chronic snoring and 13 males (mean age 60 months, range 55–67) with no history of snoring, were selected, by the use of random numbers, from new patients of the orthodontic department.
METHODS: All the children underwent nocturnal ambulatory monitoring of snoring (MESAM 4). This has been used as a comprehensive evaluation of Heavy Snoring Disease, considering the snoring pattern and the oxygen saturation during sleep and obtained a staging degree with an increase in severity from 00 to 2, and a minimum level of oxygen saturation (Min SaO_2). All the children were subjected to a cephalometric analysis of UA and to an evaluation of the anatomical structure of the head. All the cephalograms were traced on four separate occasions by the same operator, in order to reduce the error of method. The inter-group differences were evaluated with the Mann–Whitney U-test.
RESULTS: The mean age of snoring onset was 22.7 months, while for apnoea the onset was 34.7 months. The majority of the children had day-time forced oral respiration (96.2 per cent) whilst 20 per cent showed a failure to thrive. Polysomnographic results revealed 27 per cent without respiratory problems, 46 per cent with continuous snoring but without apnoea, and 27 per cent with snoring and obstructive apnoea. The mean Min SaO_2 was 90.1 per cent, with 27 per cent of the sample showing a Min $SaO_2 < 90$ per cent. The cephalometric analysis showed an increment of the craniomaxillary and intermaxillary angle, indicating a high angle face in 61 per cent of the sample. The increment of both the gonial angles indicated a vertical pattern of growth. The UA cephalometric analysis indicated the presence of a mechanical obstruction of the rhinopharynx due to enlarged adenoids. The orthodontic clinical examination revealed the presence of a crossbite in 52 per cent and lip incompetence in 69 per cent of the children.
CONCLUSION: These results indicate a morphological craniofacial type in children with habitual snoring and OSA. The increment of divergency associated with the increase in vertical development of the face, a crossbite and the lip incompetence suggest the importance of nocturnal and diurnal breathing in the development of craniofacial growth.

18 A LONG-TERM EVALUATION OF TREATED CLASS II DIVISION 2 MALOCCLUSIONS

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AIMS: To evaluate long-term changes in the occlusion, alignment, and arch form in Class II division 2 treated cases.
SUBJECTS: Pre-treatment, end of treatment and post-retention (7 ± 2.8 years) plaster cast of thirty Class II division 2 cases were assessed. Seven patients were in the mixed dentition and 23 in the permanent dentition. No lower arch extractions were carried out in any patient.
METHOD: Irregularity Index, anterior crowding, molar relationship, overbite, intercanine width, intermolar width

and arch length were measured. Association between variables was evaluated by Pearson's correlation coefficient. Differences between groups were assessed using a one-way analysis of variance.
RESULTS: Molar relationship correction was stable. The post-retention overbite increase was 0.9 ± 1.2 mm. The overbite over-correction group did not have better results than the other groups, over a long time basis. Over-correction of overbite relapse: Three cases showed unacceptable maxillary irregularity post-retention; the upper incisors showed rotation and/or labiolingual displacement relapse, with maxillary arch width and length only moderately reduced. Nine cases showed unacceptable lower irregularity post-retention; the lower severe crowding group (lower initial crowding >5 mm) showed significantly greater post-retention lower irregularity than other groups; cases treated with increase of mandibular arch width and length showed the poorest stability results of lower incisor alignment. Maxillary arch width showed minimal change post-retention. Mandibular arch width and length decreased after retention below initial pre-treatment values.
CONCLUSIONS: No variables were useful in establishing a prognosis of vertical stability. Long-term lower arch alignment was variable and unpredictable. The possibility that mandibular arch length and width increases can be maintained, is rare. Severe initial crowding cases may need to be retained indefinitely.

19 ACUPRESSURE AND NAUSEA RELATED TO MAXILLARY IMPRESSIONS

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AIM: Acupressure on P6 (Neiguan) has been shown to be an effective post-operative anti-emetic (Dundee *et al.*, 1989). The aim of this study was to establish whether it can also be therapeutic for nausea related to maxillary dental impressions.
SUBJECTS AND METHOD: Eight males and fourteen females with a mean age of 14.64 years, and whose self registration of nausea during the control impression was greater than 33 per cent of a visual analogue scale, formed the sample. The test involved a second impression with prior application of two minutes finger pressure on either P6, the sixth point on the Chinese pericardial meridian, or a dummy point on the forearm of the patient's dominant limb. The choice was randomised, and double-blind conditions prevailed, as each patient was covered by a towel during the procedure. After the withdrawal of the impression, another 100 mm visual analogue line was marked to record the degree of nausea experienced. The untrimmed control and test study models were measured down the midline to record how far the impression had extended onto the soft palate. Measurements were made to the nearest half millimetre together with double determinations for the method error. Mean and standard deviations were calculated and a Student's *t*-test was applied.
RESULTS: In thirteen patients who had acupressure on P6 there was a mean reduction of 30 per cent on the nausea scale, while nine who used the dummy point showed a mean reduction of 29 per cent. The difference was not significant. The mean lengths of the study casts were approximately 70 mm, with no statistical difference between the test and control models, which confirmed the soft palate stimulations had been consistent.
CONCLUSIONS: P6 acupressure does not reduce the sensation of nausea induced by maxillary impressions. This may provide indirect evidence that its therapeutic effect is exerted through the chemoreceptor trigger zone and not the vomiting centre.

20 THE TWIN BLOCK TECHNIQUE

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AIM: To evaluate the results of Twin Block treatment and determine the effect of treatment on growth modification.
MATERIAL: Cephalometric radiographs of 78 patients consecutively treated with Twin Blocks were compared with control values from published material from the Universities of Michigan and Nijmegen. A second study was carried out on a series of patients treated in Scotland (n = 40), England (n = 25), Canada (n = 47) and New Zealand (n = 16) and compared with the published values of the Burlington Growth Study.
METHOD: In the first study the radiographs were traced and measured manually, but in the second the radiographs were digitised into the computer. Cephalometric analysis measuring 47 linear and angular values was carried out on both samples in order to ascertain the changes as a result of treatment. These were compared with the values for normal children.
RESULTS: These showed highly significant growth changes in the treated group compared with the controls. In the first study changes included a highly significant increase in mandibular length accompanied by a reduction in maxillary protrusion. In addition there was a retraction of the upper labial segment and a 5 degree proclination of the lower incisors, which corrected during retention. The second study showed similar growth changes, although they were from different population samples. This confirmed the consistency of the changes as a result of treatment. A consistent feature was the rapid correction observed during the Twin Block phase of treatment as a result of full-time wear of the appliance.
CONCLUSION: The Twin Block is a most effective functional therapy appliance for growth modification.

21 EFFECT OF RETINOL AND OSTEOCLAST MEDIA ON RAT PERIOSTEAL OSTEOBLASTS

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AIMS: The mechanisms regulating bone formation and resorption during orthodontic tooth movement have not

been fully elucidated. In this study the effects of retinol (vitamin A) and the media of osteoclastic cells were investigated on rat periosteal osteoblasts with regard to their proliferation and alkaline phosphatase activity.
MATERIALS AND METHOD: Periosteal osteoblasts (OB) were obtained from the endocranial periosteum of newborn rat calvaria. The OBs were grown to confluence in Iscoves media (10 per cent fetal calf serum). The experiments were performed in a serum-free Iscoves media with 0.5 per cent BSA. Osteoblasts were incubated with either retinol (10^{-6}M), osteoclast conditioned media obtained from human giant cell tumour of bone (Iscoves, serum-free 24 hour exposure), or a combination of both. Cell proliferation was evaluated by incorporation of ^{3}H-thymidine pulsed for the last 4 hours of the experimental period. DNA was precipitated by trichloroacetic acid and counted in a Beckman 6000 scintillation spectrophotometer. Alkaline phosphatase (ALP) activity was measured in the media and cell lysates of the osteoblast cultures utilizing a Sigma fluorometric assay. Statistical analyses were performed by analysis of variance to determine differences between the four groups.
RESULTS: Cell proliferation at 24 and 48 hours was significantly reduced by either osteoclast conditioned media (CM), retinol (Ret), or both as compared with the control. At 24 hours there was no significant difference between Ret alone or combined with CM. At 48 hours however, the combination of CM and Ret produced the greatest reduction. Osteoblast cellular ALP activity at 24 hours was also reduced by Ret and the Ret/CM combination, but not significantly reduced by CM alone. However at 48 hours ALP activity was reduced by all treatments. The ALP activity in the media was increased at 24 and 48 hours by the Ret and the Ret/CM combination, and only after 48 hours by the CM alone.
CONCLUSION: The data suggest that retinol and cultured media of osteoclast similarly alter the state of differentiation of osteoblasts reducing cell proliferation and cellular alkaline phosphatase activity while increasing media alkaline phosphatase activity.

22 SONIC DIGITIZING VERSUS RADIOGRAPHIC CEPHALOMETRY—A CLINICAL COMPARISON

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AIMS: To determine the difference between sonically digitized cephalometric analyses and radiographically based cephalometry. Furthermore the reproducibility of sonic digitizing was tested.
MATERIALS AND METHOD: Digitizing analyses were performed using a DigiGraph® work station (Dolphin Imaging Systems, Valencia, Ca, USA) and conventional lateral cephalograms were taken with a Siemens cephalometric X-ray device (Siemens AG, Erlangen, Germany). Fifty subjects with an age range of 21–30 years were examined radiographically and sonically by two orthodontists applying the Jarabak analysis. To evaluate comparative repeatability, each of the 50 radiographs were traced consecutively three times by the same operator.
RESULTS: Statistical *t*- and F-tests showed certain difficulties in locating sella point by sonic digitization, which can only be reconstructed indirectly by this method. The standard deviations for DigiGraph data were higher than those obtained by analysis of lateral cephalograms. The reliability tests revealed comparable results for both radiographic and DigiGraph® data, although standard deviations were slightly higher for sonically digitized measurements.
CONCLUSIONS: Despite slight short-comings in clinical application, the DigiGraph® system may be a valuable tool in appropriate initial and midcourse examination. By not exposing patients to radiation it can be regarded as a useful adjunct in orthodontic diagnosis.

23 LONG-TERM RESULTS OF EARLY CLASS III TREATMENT IN THE DECIDUOUS DENTITION

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AIMS: Comparison of early and late Class III treatment; Group A: beginning at age 5 years 2 months, Group B: 8 years 10 months, and an untreated Class I group. The final investigation of all groups was carried out at 16 years of age. At the Orthodontic Department of the University Dental Clinic, Graz, early Class III treatment beginning in the deciduous dentition started some 20 years ago. Chin cap and Fränkel's functional regulator both worn simultaneously 24 hours a day are the routine appliances. After a treatment time of 3 to 6 months a correct overbite and overjet are usually achieved. The appliances are then worn for 6 months at night only and then the treatment interrupted. However, the observation period of Class III treatment lasts at least 2 years after the patient has entered puberty. During that time a chin cap is worn when the overjet seems to diminish. Fixed appliances are sometimes necessary after the eruption of the permanent teeth.
MATERIALS AND METHOD: A group of 13 patients whose treatment started at the mean age of 5 years 2 months (group A) were compared with a group of 11 patients with a mean age of 8 years 10 months (group B) at the beginning of the treatment. Both groups were also compared with an untreated Class I group. Groups A and B received full Class III treatment and were compared again at the age of 15–16 years. The final data comprised the age of 18 years for group A and the age of 24 years for group B (ANOVA, paired samples *t*-test).
RESULTS AND CONCLUSION: At the age of 16, group A showed a significant decrease of Sella angle and increase of Articulare angle in comparison with the Class I group, while group B showed similar but not significant tendencies. The Gonial angle was only significantly larger in group B. The SNA angle was significantly smaller in group B. It was

also smaller in group A, but not significantly. No significant differences could be found in SNB angles.
The ANB differences were 0 degrees in group A and −2 degrees in group B, compared with 2 degrees in the Class I group. Both figures are significant. The upper incisors were 108 degrees in group A, and 111 degrees in group B, compared with 104 degrees in the Class I group. The lower incisors were 86 degrees, 83 to 94 degrees respectively. All figures were significant.
CONCLUSIONS: These measurements prove that early treatment beginning in the deciduous dentition is much more effective than the late start around the age of 8 years. This can even be better demonstrated on the patients treated early, all of whom are almost skeletal Class I. No failure could be found in that group.

24 TOPOGRAPHIC COMPARISON OF ELECTROMYOGRAPHIC ACTIVITY OF THE MASSETER MUSCLE BEFORE AND AFTER SURGICAL BITE CORRECTION

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AIMS: This study investigated the topographic changes in electromyographic activity when combining orthodontic treatment and surgery.
SUBJECTS AND METHODS: A total of 30 adult patients with pronounced Class II (n=15) or Class III (n=15) anomalies were included in the evaluation. All of them had surgical bite correction. In addition monopolar surface electromyography (EMG) of the masseter was performed on all patients before and after surgery by simultaneous tracings from 16 electrodes. This permits recording of the distribution pattern of muscle excitation (myomapping). Readings were made under various conditions (pressing, chewing, swallowing, and protrusion against a defined force). Twenty eugnathic adults served as controls.
RESULTS: As against their pre-operative EMGs, Class II patients showed distinct harmonisation of the excitation pattern to resemble that of eugnathic patients. After surgical bite correction in Class II patients a caudal shift of activity peaks was registered, which prior to the operation had been traced in the central muscle third. By contrast, excitation peaks were found to advance cranially in Class III patients with caudal EMG activity, a typical finding in eugnathic patients, and these continued to decrease post-operatively. It follows that there is a shift of the excitation pattern of Class II patients to the direction of eugnathic distribution while the pattern of Class III patients remained unfavourable.
CONCLUSIONS: The deviations found in the masseter excitation pattern of Class III patients are indicative of the risk of relapse and of the long-term phase of retention required. Surgical bite correction in Class II patients, on the other hand, results in a harmonisation of the excitation activity and thus in functional adjustment to the change in morphology.

25 REFINING THE MIDFACE RATIO FOR ESTIMATING PROGNATHISM IN BINDER'S SYNDROME

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In straight lateral radiographic cephalometry, prognathism of the maxilla is conventionally determined by the SNA angle. However, in Binder's syndrome, the SNA angle is inapplicable because point A cannot be determined according to current definitions, all of which presuppose a forward concave subspinal contour. A midface ratio (MFR) composed of the upper and lower midface lengths, the anterior midface height, and the posterior maxillary height, was found to be a valid alternative to the SNA angle. In a theoretical midface ratio (TMFR) established in parallel with MFR, estimation of the lower midface length is done by use of the mean value, in normal anatomy, of the distance from the anterior surface of the maxilla to the upper medial incisor apex. The TMFR is equally applicable in Binder's syndrome and normal anatomy, but can be criticized for the measuring to incisor apices. A refining of the method would be to estimate lower midface length irrespective of incisor position.
AIM: To estimate the mean horizontal dimension of the skeletal defect in Binder's syndrome, and to investigate the reliability of a Binder midface ratio, (BMFR) established in parallel with previous ratios and by use of the mean value for the skeletal defect.
METHODS: The anterior portion of the maxilla in tracings of 35 subjects with Binder's syndrome were, in turn, superimposed on each tracing of 24 subjects with normal maxillary anatomy and occlusion. The palatal tines were used for vertical positioning, and the buccal and lingual projections of the marginal crests for horizontal positioning. The size of the defect in Binder's syndrome was measured as the distance between point A projection on the palatal line and the intersection of the palatal line on the anterior skeletal contour in Binder's syndrome. Three-factor ANOVA was performed.
RESULTS: The 95 per cent confidence intervals for the mean horizontal dimensions of the skeletal defect in Binder's syndrome were 8.0 ± 0.4 mm for men, and 5.6 ± 0.2 mm for women. The location and range of BMFR values in Binder's syndrome was the same as for MFR values in normal anatomy. Classifications of prognathism by BMFR, using the interval of orthognathia in MFR, accorded with classifications by TMFR for all subjects but four. However, both BMFR and TMFR classified 11 subjects as having maxillary retrognathia, 22 as orthognathic, and two as prognathic.
CONCLUSIONS: The present estimations of the mean skeletal defects in Binder's syndrome can be considered to be precise. When classifying the degree of prognathism by BMFR, the reliability may exceed that of classification by TMFR. Classifications by BMFR confirm that the degree of prognathism in subjects with Binder's syndrome varies, in contrast to the general belief, from retrognathia to prognathia.

26 SHAPE-COORDINATE STUDY OF SKELETAL CHANGES IN TREATED CLASS III CHILDREN

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AIM: To assess size and shape changes of both maxilla and mandible induced by early treatment of Class III malocclusion with a functional appliance (Removable Mandibular Retractor, RMR) by means of shape-coordinate analysis (Bookstein, 1991).
SUBJECTS: A group of 30 treated Class III children (18 males, 12 females), age at the first observation (before treatment) 5.64 ± 1.01 years, age at the second observation 8.43 ± 1.73 years, was compared with a control group of 30 untreated Class III children (13 males, 17 females), age at first observation 6.06 ± 1.14 years, age at the second observation 8.45 ± 1.79 years. The observation period was 2.86 ± 1.08 years for the treated group and 2.39 ± 1.28 years for the control group.
METHOD: Maxillary triangles (point T, the most superior point of the anterior wall of sella turcica, point FMN, fronto-maxillary-nasal suture, point A) and mandibular triangles (points Condylion, Gonion, Pogonion) were digitized directly on cephalograms in both groups at first and second observations. Modifications in shape were calculated as shape-coordinate changes for point A using T–FMN as the baseline and for point Co, Go–Pg as baseline. Size changes were evaluated by analysing centroid size changes. F-statistics were applied on shape-coordinate vectors and on the centroid size measurements ($P < 0.05$).
RESULTS: As to shape changes, RMR was able to produce a significant enhancement of the forward growth of the maxilla and a significantly more upward-forward direction of growth of the mandibular condyle when compared with the control group. Upward-forward direction of condylar growth is a biological mechanism (anterior morphogenetic rotation) leading to smaller increments in mandibular total length (Co–Pg). Both maxillary and mandibular size were significantly affected by early treatment.
CONCLUSIONS: Interceptive treatment of Class III with a functional appliance induces significant skeletal changes which involve both shape and size of the maxilla and of the mandible.

Bookstein F 1991 Morphometric tools for landmark data. University of Cambridge Press, New York

27 INTEGRATION OF THREE-DIMENSIONAL METHODS IN THE TREATMENT OF SEVERE CRANIOFACIAL ANOMALIES

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AIM: Does the integration of three-dimensional cephalometry and 3D-model surgery in patients with severe craniofacial anomalies allow a higher precision in orthodontic and surgical diagnosis and treatment planning?
SUBJECTS AND METHOD: Fifteen adult patients with asymmetrical craniofacial deformities were selected and axial CT-scans were generated. Based on this CT-data, 3D-images were constructed with a standard PC-system and a new software program to evaluate the skin and skull cephalometrically in all three planes. In complex craniofacial deformities the dataset is transferred to generate individually milled polyurethane or stereolithographical fabricated models.
RESULTS: Three-dimensional cephalometry with a standardized PC and user-specified software permits a high degree of flexibility independent of expensive computing workstations. After the definition of anatomical landmarks on the skin or bone surface, various measurement tools permit a three-dimensional cephalometric analysis on the monitor. The degree of asymmetry of the skull and skin morphology could be evaluated quantitatively with different procedures. The milled skull models allow the simulation of various orthodontic and surgical treatment procedures. This presents a new quality of model surgery. In stereolithographical models the hollow spaces such as the maxillary sinus and the nerve canals, can be seen.
CONCLUSION: Three-dimensional cephalometry on a standardized PC-system enables every clinic and private practice a quantitative assessment of the craniofacial morphology, especially the degree of asymmetry. Individual treatment planning with 3D-skull models represents a new quality of model surgery, which at present is still limited to cases of severe craniofacial deformities.

28 COMBINED ORTHODONTIC-SURGICAL TREATMENT OF SEVERE CLASS III MALOCCLUSION

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AIM: To investigate morphological characteristics and different approaches used to correct severe Class III malocclusions by combined orthodontic-surgical treatment.
SUBJECTS: One hundred and four consecutive adult patients with severe Class III malocclusions who had undergone orthodontic-surgical treatment.
RESULTS: Eighteen per cent of the subjects had maxillary deficiency, 59 per cent mandibular prognathism, and 23 per cent double jaw deformity. Over 60 per cent had bimaxillary surgery. The maxillary surgery was usually a Le Fort I in 1–4 segments. The mandibular surgery comprised ramus or body osteotomies (Step or Hofer osteotomy) or both ramus and body osteotomies. Ninety per cent of the subjects required pre- and post-surgical orthodontics.
CONCLUSIONS: In the severe Class III malocclusions treated, mandibular prognathism was more common than maxillary deficiency or two jaw deformity. The correction required orthodontic interaction in the majority of the

subjects and two jaw surgery, which will be illustrated in the presentation.

29 ORTHODONTIC PROCLINATION OF LOWER INCISORS AND GINGIVAL RECESSION

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AIM: To answer the question, if orthodontic proclination of lower incisors results in gingival recession.
SUBJECTS: One hundred children treated with the Herbst appliance were surveyed. Lateral head films, dental casts and intraoral photographs from before and after Herbst treatment, as well as six months after treatment, were analysed. A total of 400 lower incisors were evaluated.
METHOD: On the lateral head films the inclination (IL/ML) and the sagittal position (ii/OLP) of the lower incisors was assessed according to the method of Pancherz (1982). Crown height measurements were performed on the dental casts and the gingival condition was assessed on the intraoral photographs.
RESULTS: In all subjects Herbst treatment resulted in a varying amount of lower incisor proclination. In 50 teeth (13 per cent) minor gingival recessions existed before treatment. In 31 (8 per cent) of these teeth the recessions remained unchanged during treatment, in 15 (4 per cent) the recessions improved and in 4 teeth (1 per cent) the recessions worsened. Gingival recessions developed in only 8 teeth (2 per cent) during Herbst treatment. For these teeth the mean increase in crown height was 0.4 mm. No interrelationship was found between the degree of incisor proclination and the development of gingival recessions.
CONCLUSION: Orthodontic proclination of lower incisors in children is not thought to result in gingival recession.

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

30 ADULT ORTHODONTICS

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(KEYNOTE ADDRESS)

Adults, being by definition non-growing, may be considered prone to particular difficulties in three areas of orthodontic tooth movement, namely distal movement of molars, overbite reduction and space closure, since all of these are known to be facilitated by growth. In addition, headgear wear might be expected to be more problematic socially in adults.
Clinical experience only partially supports these views and the work by authors such as Forsberg and Behrents on adult facial growth may partly explain this experience. However, further research into the prevalence of difficulties with orthodontic space closure in adults would be helpful, as would an investigation of headgear compliance, using the methods described by Cureton, in adult patients.

31 THE MORPHOLOGY OF THE NOSE IN PATIENTS WITH UNILATERAL CLEFT LIP AND PALATE USING THREE-DIMENSIONAL TECHNIQUES

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AIM: The project aimed to investigate the growth of the nose in 35 patients from the age of 4–16 years with unilateral clefts of the lip and palate who had been operated on by one surgeon, and to compare this with the growth of noses in 56 non-cleft children of similar ages.
METHOD: The patients were scanned using a non-invasive three-dimensional optical surface scanner and were subdivided by age and sex into groups of 4–8, 9–12 and 13–16 years. Each of the age groups were averaged to give an average scan for that particular group, and using a registration programme the differences between each of the facets of the two scans was displayed in colour. Various dimensions of the nose were measured on the optical scan.
RESULTS: The female 4–8 year age group demonstrated a difference from the noses of the cleft group, being wider by 3–5 mm than those of the control group of the same age. There was also a marked deficiency of the middle third of the face by 7–9 mm. At 9–12 years bone grafts had been undertaken and the deficiency of the middle third of the face had improved and the width of the alars of the nose had reduced. At 16 years the noses of the clefts were wider and the tip less prominent and there was a deficiency in the lower third of the face. In the male group the changes were similar to the females in the 4–8 year age group. At age 9–12 males have wider noses and a deficient upper lip and mandible compared with the control group. At 16 years there is a deficiency of the tip of the nose by 7–9 mm but the height of the face had increased.
CONCLUSION: Although there was considerable improvement in the facial form of the cleft patients following surgery and bone grafting, the facial morphology is still deficient in the area of the nose.

32 PATHOLOGY OF CRANIOFACIAL DEFORMITIES: A STUDY BASED ON TWO- AND THREE-DIMENSIONAL COMPUTERTOMOGRAPHY

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On the basis of the complexity of anatomical abnormalities in patients suffering from craniofacial deformities it is not possible to determine the three-dimensional characteristics of bony dysplasia and structural changes by conventional radiographic techniques.

Therefore, 80 patients with different craniomandibular syndromes (Goldenhar, Franceschetti, Freeman-Sheldon, Scheuthauer-Marie-Sainton etc.), craniofacial asymmetries, and cleft lip and palate patients were analysed by computer-tomography (CT) using Spiral-CT-technique, pitch 2, and 1–2 mm slice thickness. Multiplanar secondary and 3D-surface reconstructions were generated in order to determine the dysmorphology three-dimensionally. Additionally measurements of the bone mineral density (BMD) were performed in order to detect structural anomalies.

Despite the heterogeneous examination group and the great variety of special symptoms pertaining to certain subgroups, the cranial base morphology was disharmonious in 80 per cent, and the anatomy of the midface was found to be changed in 98 per cent of all cases. Ninety-one per cent of the patients examined showed bony structural abnormalities in the temporal and occipital areas of the skull. A reduced or missing pneumatisation of the mastoid bone was detected in 75 per cent of the cases, and in patients with cleidocranial dysostosis, hypersclerotic bony structures of 1350 HU were found. Striking abnormalities of the naso-maxillary part of the face could be identified by 3D-CT.

Using CT for craniofacial diagnosis, new concepts of bony dysplasias and structural disturbances could be identified, which are not only of diagnostic interest, but are beneficial for individualized and co-ordinated interdisciplinary therapy.

33 MODIFICATION IN ROOT RESORPTION IN SUBMERGED DECIDUOUS MOLARS

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AIM: To determine the morphological variations in root resorption in submerged deciduous teeth.

MATERIALS AND METHOD: Thirty-two submerged deciduous molars were carefully dissected and prepared for decalcified and undecalcified sections of 3–5 µm. The specimens were cut in longitudinal and vertical directions. In total, 1212 sections were prepared and stained with Haematoxylin and Eosin and Toluidine Blue. Examination was performed under light microscopy.

RESULTS: In all severely affected teeth a special form of root resorption was found. The resorption did not start at the root surface but in the root canals and pulp chamber. Large numbers of resorption lacunae of different sizes were found which were later substituted by bone. Resorption and bone apposition appear to occur alternately and begin at the inner surface of the tooth. Later, resorption lacunae were also observed on the root surface, leading in some areas to ankylosis.

CONCLUSIONS: Ankylosis may not be the beginning of the process leading to infraocclusion of deciduous molars but the end phase of a very special root resorption process of long duration.

34 THE DEVELOPMENT OF GINGIVAL RECESSION IN ADULTS WITHOUT ORTHODONTIC TREATMENT

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AIM: Different and partly contradictory statements on the epidemiology and aetiology of gingival recessions are found in the literature. Apart from anatomical factors such as a false position of the teeth, occlusal trauma, and chronic tooth brushing, trauma in the development of this involutional periodontal disease will be discussed. From a prophylactic point of view it is important to fully understand the meaning of aetiological factors for the pathogenesis of gingival recession in order to determine whether orthodontic treatment is necessary.

SUBJECTS AND METHOD: One hundred subjects, 18–28 years of age, with no previous history of orthodontic treatment, were examined. Analysis included recession, sagittal and vertical overbite, occlusion, rotation and false position of teeth, as well as transversal malocclusion.

RESULTS: Recessions were found in large numbers with false sagittal overbite, Angle Class III subjects, rotated or externally positioned teeth, as well as with false transversal occlusion, while a deep bite seemed to have a favourable effect.

CONCLUSION: These results therefore support the assumption that anomaly, morphology of the cranium, and the thickness of the alveolar bone do have an influence on the development of recessions.

35 ASSESSMENT OF MASTICATORY PERFORMANCE

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AIM: To develop a method to meet the interests of having a practical diagnostic tool to assess the chewing capacity and its change after occlusal rehabilitation.

METHOD: The basic idea is to spectrophotometrically apply the fact that the total surface area of a given sample is proportional to the reciprocal of the diameter. This was undertaken by incorporation of a cationic colour binder (Praestol) in a test material (a mix of barium sulphate and carnauba wax) which has the ability to form an insoluble complex with an anionic colour solution (erythrosin) leading to a change in its spectrophotometrical absorbency. The chewing capacity could then be measured as the difference in the absorbency between a standard solution and the supernatant after it has been incubated with the masticated test material.

MATERIAL: A series of artificially pulverized test material, with well-defined diameters and two repeat maximal chewing performances with ten chewing strokes, was assessed in 15 adults.

RESULTS: A near linear relationship ($r=0.997$) between the colour absorption and reciprocate of the diameter of

the particles was observed. Duplicate performance registrations within one hour revealed no systematic error, but the intra-individual variation was almost as high as the biological variation in the sample (0.08 and 0.13, respectively). Thus, based on this sample with a total range from 0.57 to 1.10, an inter-individual difference less than 0.16 should be considered non-significant.
CONCLUSION: The imperfection in reproducibility may be due to the impossibility to exactly repeat the chewing performance and/or the difficulty in collecting the masticated particles.

36 IMPROVING THE BOND STRENGTH OF ORTHODONTIC BRACKETS ON PORCELAIN RESTORATIONS

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AIM: Orthodontic treatment of adult patients with fixed appliances has become common in clinical practice. Extensive prosthetic restorations often limit the use of aesthetic appliances, such as metal or ceramic brackets, and commit the orthodontist to use bands with the obvious disadvantages in comfort and appearance. With bridges even this may be impossible. Normal bonding with conventional adhesives systems usually leads to bond failure. The aim of the present study was to test new bonding methods for a clinically acceptable bond strength, without damaging the prosthetic porcelain restorations.
MATERIALS AND METHOD: The bond strength of metal brackets on porcelain veneers was measured using an Instron testing machine. The orthodontic brackets were bonded on the test pieces in different ways: micro-sandblasting only in combination with conventional adhesives; micro-sandblasting in combination with conventional adhesives and two types of bond enhancing primers; hydrofluoric acid etching and primer; bond enhancer primer only. The most popular porcelain veneer materials were tested for differences in shear bond strength. Conventional bonding on bovine enamel served as a control group. Each of the porcelain veneers was embedded in acrylic, bonded, and tested for shear force.
CONCLUSIONS: The results show that the micro-sandblaster, which can be applied intraorally, and surface conditioning with hydrofluoric acid used in combination with primer, increased the bond strength of metal brackets on porcelain restorations to the same degree as conventional bonding on enamel with the acid-etching technique.

37 IMPROVEMENT OF FACIAL AESTHETICS IN UCLP PATIENTS THROUGH LE FORT I OSTEOTOMIES

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AIM: Orthognathic surgery has become a standard tool in secondary corrections of patients with clefts of the lip, alveolus and palate. Recently some centres have included aesthetic impairment as an indication for orthognathic surgery in this group, and consequently have also changed the orthodontic treatment regime. This study aimed to establish how much improvement can be achieved for Unilateral Cleft Lip and Palate (UCLP) patients subjected to orthognathic surgery.
SUBJECTS AND METHOD: A group of 40 adult UCLP patients treated by maxillary advancement on a Le Fort I level and, if necessary, vertical correction, were studied with regard to the aesthetic improvement of the profile. Lateral headplates before and after combined orthodontic-orthognathic treatment were evaluated cephalometrically, and standardized shadow profiles were created. These were subjected to aesthetic assessment by 10 laypersons and 5 trained professionals.
RESULTS: There was a clear improvement in aesthetic rating after orthognathic surgery. In 92 per cent of the cases the ratings for the second picture were better or equal to the first. No difference in the perception of facial aesthetics could be found between professional judges and laypersons.
CONCLUSIONS: Maxillary advancement in almost all cases leads to substantial improvement of the profile in cleft patients. The benefits are of such importance that orthodontists should take this option into account early in their treatment planning. This is especially important as it often involves a change in orthodontic objectives.

38 EFFECT OF FEEDING ON THE DEVELOPMENT OF MASTICATORY JAW FUNCTION

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(KEYNOTE ADDRESS)

AIMS: The inter-relationship of functional and morphological development of masticatory muscles from animal experiments will be discussed. A possible explanation for unstable jaw movements in patients diagnosed as having temporomandibular disorders (TMD) will be examined from the point of lower development of masticatory function.
MATERIALS AND METHOD: The facial skeleton, temporomandibular joint, masticatory muscle and tooth attrition in mice raised on a liquid died from the weaning period, were measured and histochemically stained and compared with mice raised on a solid diet.
Electromyographic activity of the masticatory muscles in two groups of rats reared on either a hard or liquid diet were also compared.
Cephalograms, magnetic resonance imaging, jaw movement patterns and EMG activity were analysed in patients with temporomandibular dysfunction and compared with subjects without any signs of TMD.
RESULTS: The jaw bones, temporomandibular joints and masticatory muscles were smaller and less differentiated in mice raised on a liquid diet. Attrition on molar surfaces in the liquid group indicated a pattern of habitual grinding.

In the rats fed a liquid diet EMG recordings showed an unstable and higher muscle activity when chewing apple cubes. The timing of muscle activity among several muscles was different when compared with those of the solid diet group.
The mandibular condyle was more slender and jaw movement and EMG activity was unstable in most patients with TMD.
CONCLUSIONS: Feeding behaviour during the growing period influences not only the morphological but also the functional development of the masticatory organ. Functional and morphological features of the masticatory organ in patients with TMD resemble those found in animals reared on a liquid diet.

39 EARLY MANAGEMENT OF HEMIFACIAL MICROSOMIA

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(KEYNOTE ADDRESS)

Early surgical intervention in hemifacial microsomia has been a contentious issue for several decades, and the indications for and the timing of such surgery is still confused.
The records of more than 100 patients with hemifacial microsomia seen during a 20 year period were analysed retrospectively and this address concentrates on the outcome of mandibular reconstruction carried out between the ages of 12 months and 12 years. Approximately 50 patients were so treated at a variety of ages; half received costochondral grafts while the majority of the remainder had ramus-lengthening procedures with inter-positional bone-grafting. The outcome of the costochondral graft patients was predictably worse, as this group included some of the most severely affected patients. The main problem with costochondral grafts was the unpredictable growth that occurred; approximately half grew (in length) more or less normally, while the remainder exhibited either under or overgrowth. The incidence of overgrowth differed from that observed in a similar group of temporomandibular joint ankylosis patients treated during the same period, and several different patterns of overgrowth were seen.
The sole indication for mandibular reconstruction in very young children was the presence of obstructive apnoea. Early treatment of affected patients proved extremely effective at eliminating the need for permanent airway maintenance. The introduction of distraction osteogenesis will clearly affect the way such patients are managed in the future, but is unlikely to obviate the need for costochondral grafts in those patients with agenesis of the ascending ramus or temporomandibular joint.
While mandibular lengthening is reasonably successful in the majority of patients with hemifacial microsomia, restoration of facial symmetry is sometimes disappointing due to a combination of medial displacement of the affected ramus and lack of overlying soft tissue mass.

40 GENERATION OF MASTICATORY MUSCLE VOLUME DURING FUNCTIONAL TREATMENT IN HEMIFACIAL MICROSOMIA PATIENTS

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AIM: The aim of this clinical study was to measure masticatory muscle volume before and during treatment with a functional appliance in young children with congenital lack of normal condylar growth, in order to analyse the morphological and functional basis for a successful treatment result.
SUBJECTS AND METHODS: The paper reports the analysis of three female children aged between five and nine years selected from a sample suffering from congenital and acquired craniofacial malformations and being treated by means of activators, one with otomandibular syndrome, one with mandibular dysostosis, and one with Goldenhar syndrome. The clinical examination before and during active treatment included extraoral anterior and lateral views, an intraoral three-dimensional analysis, palpation and auscultation of the TMJ, as well as assessment of the range of mandibular movements.
Spiral-CT examination was carried out with a Somatom Plus S spiral scanner. Scanning was done in the axial plane starting at the level of the external auditory meatus over a distance of 3–4 cm. From the axial images, standard coronal, parasagittal, paracoronal and 3-D images were obtained using the Siemens reconstruction software. Linear and angular measurements of the bony structures were performed on the screen. For evaluation of the size of the masticatory muscles, the software program Volumetry was used.
RESULTS: Depending on co-operation and duration of active treatment, the three patients showed improvement or restoration of normal function and facial symmetry, as well as reduction in the intraoral midline deviation. The pre-treatment volumes of the temporal, masseter and lateral pterygoid muscles on the affected side were smaller than on the contralateral side. The analysis after at least one year of treatment revealed an increase of muscle size on the affected side compared with the unaffected side.
CONCLUSION: The results show that treatment should be initiated as early as possible since the first morphological treatment effect found in the patients in this investigation was an increase of masticatory muscle volume which may be followed by an apposition of hard tissues.

41 FUNCTIONAL APPLIANCES AND INTERCELLULAR MATRIX IN THE MANDIBULAR CONDYLE

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AIM: The aim of this investigation was to find an explanation for the phenomena that with functional appliances

favourable histological changes are observed, which lead, however, only to limited macroscopic changes. This study therefore looked at the total amount and nature of proteoglycans and collagen in the condylar cartilage.
MATERIALS AND METHOD: Twenty 5-day-old New Zealand rabbits underwent surgery to induce premature synostosis of the cranial sutures, resulting in posterior displacement of the glenoid fossa. As far as the condyle was concerned, the purpose was to simulate the protraction of the mandible that occurs in association with functional orthopaedic treatment. Twenty sham-operated rabbits served as controls. The animals were killed at the age of 15 days for histochemical and biochemical analyses.
RESULTS: The collagen and proteoglycan content of the superior region of the condyle was markedly reduced in the treated animals as compared with the controls. Aggregating proteoglycans in particular had decreased in amount. This indicates that either the catabolism of proteoglycans had exceeded their synthesis, or the proteoglycan monomers synthesized had been unable to aggregate, resulting in a more marked escape from the tissue.
CONCLUSIONS: It is concluded that continuous jumping of the mandible forwards, while causing a marked reduction in the quantity of both collagen and proteoglycans in the cartilage tissue of the mandibular condyle, will also induce changes that resemble those observed in association with animal models of arthritis. It is possible that these two phenomena have similar mechanisms. During orthopaedic treatment in growing subjects favourable changes are observed due to greater capacity of the mandibular condyle for remodelling.

42 AETIOLOGY-ORIENTATED SYNDROMOLOGY BASED ON DEVELOPMENTAL FIELDS IN CRANIOFACIAL EMBRYOLOGY

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AIMS: The purpose of a series of earlier and ongoing studies has been to visualize developmental fields with a common aetiology in the face, craniofacial skeleton and central nervous system in the search to establish an aetiology-based syndromolgy.
MATERIALS AND METHOD: Approximately 280 normal fetuses from spontaneous and induced abortions [gestational age (GA): 4 26 weeks] formed the basis for mapping the normal development of the craniofacial skeleton, comprising the mandible, the maxilla, the cranial base, the nasal cavity and the theca cranii.
From a collection (totalling about 210) of pathological fetuses from spontaneous and induced abortions (GA: 11–27 weeks), the craniofacial development was charted and compared with normal patterns. The pathological fetuses presented with neuropathological malformations (holoprosencephaly, anencephaly, spina bifida, etc.), and fetuses with known chromosomal disorders such as trisomy 18, trisomy 21, trisomy 13 and triploidy. The latter are currently under study.
Radiological and histochemical techniques, including immunohistochemistry, formed the basis of the study.
RESULTS: The studies show that there is a relationship between the development of the central/peripheral nervous systems on the one hand, and the development of the face and the craniofacial skeleton on the other. Three developmental fields have been described in each jaw, and so far two in the cranial base. There are two developmental fields in the frontal bone and one in the nasal bone. The origins and extent of the individual fields will be presented.
CONCLUSIONS: In different syndromes different fields of development are involved. The extent of the malformations within the individual fields can vary. By analysing developmental fields, the syndromology can be changed from being a symptom-descriptive discipline to an aetiology-orientated discipline.

43 VALIDITY OF COMPUTERIZED CEPHALOMETRIC PREDICTION OF PROFILE CHANGES AFTER ORTHOGNATHIC SURGERY

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AIMS: To evaluate the validity of the prediction of dentoskeletal and soft tissue profile changes in mandibular setback and maxillary impaction osteotomies using the computerized cephalometric system, Dentofacial Planner.
SUBJECTS AND METHOD: The sample comprised 18 patients who received vertical ramus osteotomy for mandibular setback, and 14 patients with Le Fort I or bilateral posterior osteotomies for impaction of the maxilla. Lateral cephalograms taken at the end of pre-operative orthodontics, within one week prior to surgery, and approximately one year after the operation were available. Following cephalometric tracing of structures, construction of a co-ordinate system and assessment of the operative changes by means of superimposition, all pre-operative and post-treatment tracings were digitized and entered into the Dentofacial Planner 6.0 system. Starting from the pre-operative tracing the computerized system was instructed to alter the position of skeletal structures, thus simulating the three different osteotomies. Comparison of the computerized prediction and actual post-treatment cephalometric tracing printouts was made by means of 59 linear and angular dentoskeletal and soft tissue profile cephalometric variables.
RESULTS: The main findings of the study for the mandibular setback group indicated a tendency for the computerized predictions to place the mandible less posteriorly than the actual situation, and to significantly decrease the mandibular plane inclination, the total anterior skeletal and soft tissue face heights, the lower anterior skeletal face height, and the upper lip height.

In the maxillary impaction group the few significant differences indicated that the prediction printouts demonstrated significantly increased values in the total anterior soft tissue face height, the upper lip height and the inclination and curvature of the lower lip, and decreased soft tissue thickness in pogonion and point B regions.
CONCLUSIONS: Taking the results of this study collectively it may be concluded that the Dentofacial Planner seems to have some problems with the accuracy of the post-treatment dentoskeletal and soft tissue profile predictions in mandibular setback and maxillary impaction osteotomies.

44 INTERDISCIPLINARY MANAGEMENT OF TORTICOLLIS IN CHILDREN

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AIMS: It is known, that the long-term effects of torticollis in children are severe. It is therefore important that orthodontists and paediatricians know how to recognize and manage children with torticollis. This presentation demonstrates the role of the orthodontist in the treatment team.
SUBJECTS AND METHOD: The interdisciplinary study group treated 58 children with torticollis in 1994. Dysfunction in various areas was detected by use of manual and osteopathic techniques. All findings were recorded on a computer.
RESULTS: Important keynote areas in diagnostics and therapy were found. The sternocleidomastoid muscle is an important area, but as important is the function or dysfunction of the occipitale, temporale, and sphenoidale frontal muscles, the atlanto-occipital joints, the occipitomastoid suture, the dura and the ileosacral joints. Therefore the orthodontist has to practice basic techniques in all children as a screening test to evaluate torticollis. Furthermore two ways of interdisciplinary treatment procedures will be demonstrated using the classification developed by the authors. The importance of specific treatment techniques and recall is stressed.
CONCLUSIONS: The role of orthodontists in detecting children with torticollis is important. In future it could be helpful for all colleagues to use a simple manual diagnostic scheme regarding the biophysical relationships in the arthromuscular control loops described in this presentation.

45 RADIOGRAPHIC AND TOPOGRAPHIC INVESTIGATION OF ROOT RESORPTION DURING PREMOLAR INTRUSION

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AIM: To evaluate the changes in root length and root surface topography in human upper premolars following the application of an intrusive force of different durations.
SUBJECTS AND METHOD: This study was carried out on 50 adolescent patients in whom bilateral extraction of upper first or second premolars was required as part of treatment planning. The patient were divided into three groups which included 13, 18 and 19 individuals respectively. Distribution of the individuals according to gender and age was similar in all groups. In the first group intrusion lasted one month (30 days) and in the second and third groups, two and three months, respectively. One premolar on one side of the upper arch served a the experimental tooth while the contralateral one was taken as the control. Experimental teeth were intruded by a rectangular loop made of 0.017×0.025" TMA, activated to deliver a force of 2 ounces. Force maintenance was achieved by activating the loops every two weeks. No operation was performed on the control teeth. The teeth were extracted at the end of the experimental periods and then prepared for examination under a scanning electron microscope (SEM). The changes in root length were measured on periapical radiographs taken at the beginning and end of the experimental periods using a long-cone technique. Individual acrylic bite blocks fixed to film holders were used in order to achieve standardization of the radiographs. Measurements were made on a total of 200 periapical radiographs taken from 100 premolars using a slide projector adjusted to produce $\times 10$ magnification of the images.
RESULTS: Statistical evaluation of the radiographic measurements showed that shortening of the roots in the 3-month group was highly significant ($P<0.001$) with a mean of 0.47 mm when compared with their controls. Root shortening in the 2-month group was also significant ($P<0.01$) with a mean of 0.41 mm. No significant root shortening was found in the 1-month group. Comparison of the 3 month group with the 2 month group showed a significant difference while no significant difference was found between the 1 and 2 month groups. As for SEM investigation, control teeth showed relatively regular cementum surfaces with only minor superficial resorption in the apical third. In all three experimental groups teeth receiving the intrusive force displayed a greater number of resorption areas compared with their controls. The most severe resorption was observed in the 3-month group with numerous and large resorption bays which penetrated into dentine. The apices seemed to have flattened when compared with their controls. Resorption cavities around the apices were smaller in diameter than the ones in the middle and cervical thirds. The root resorption pattern in the 2-month period was very similar to resorption in the 3-month period. Root resorption in the 1-month period was minor when compared with the previous groups. There was no apparent flattening of the apices, however there were still numerous resorption pits around the apical foramen. The middle and cervical portions of root surfaces were very similar to their controls.
CONCLUSIONS: These results indicate that during intrusion, even a light force when applied for a long duration can result in a considerable amount of root shortening. The extent of root resorption and apical flattening increases with increasing duration of force. Duration of the intrusive force is a critical factor from the point of resorption.

46 PALATAL SURGERY WITHOUT DENUDATION OF BONE PERMITS DENTOALVEOLAR DEVELOPMENT

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AIMS: Scar tissue formation after surgical repair of the palate is considered to be a major cause for disturbance of maxillary growth. In animal experiments it has been found that surgery without denudation of the palatal bone results in more favourable dentoalveolar development (Leenstra *et al.*, 1995). During the last 20 years, Kohama and co-workers have performed two types of palatal closure in cleft palate cases i.e. with and without denudation of palatal bone. The aim of this study was to evaluate the pre- and post-operative course, and the dentoalveolar development of the deciduous dentition in unilateral cleft lip and palate (ULCP), and cleft palate patients (CP) up to 5 years after these two different types of palatal repair.
SUBJECTS AND METHOD: The supraperiosteal flap technique (SP), not resulting in denuded bone, was used in 35 UCLP and in 33 CP patients. The mucoperiosteal technique (MP) which results in denuded bone was used in 30 UCLP, and in 40 CP patients. In all groups, palatal repair was performed at a mean age of 17 months. Operation procedure, time required for surgery, and wound healing was studied. The dentoalveolar development was evaluated annually on dental casts until 5 years post-surgery.
RESULTS: The arch depths of the SP-groups were larger than those of the MP-groups. This difference increased with age. No significant differences in arch width were found except for the distance between the first deciduous molars, which was wider in the SP-group at the end of the 5-year period.
CONCLUSION: In the deciduous dentition sagittal maxillary development is superior after the SP-technique compared with the MP-technique. Therefore with respect to later maxillary growth, a surgical procedure in which denudation of palatal bone is avoided is to be preferred above other techniques.

Leenstra T S, Maltha J C, Kuijpers-Jagtman A M, Freihofer H P M 1995 International Journal of Oral and Maxillofacial Surgery

47 VERTICAL FACIAL DEFORMITY AND EXTRA-CELLULAR MATRIX EXPRESSION IN MASSETER MUSCLES

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AIM: Increased extra-cellular matrix (ECM) accumulation has been shown in skeletal muscles of patients with primary muscle pathology, for example, muscular dystrophy (Rampoldi *et al.*, 1986). Such patients are characterised by extreme vertical development of the face. Matrix turnover is regulated by a number of interactive enzyme/inhibitor cascades including the matrix metalloproteinases (MMPs) and their specific inhibitors, the tissue inhibitors of metalloproteinases (TIMPs). The aim of this study was to investigate the role of ECM accumulation in masseter muscles of patients with vertical facial deformity of developmental origin.
MATERIALS AND METHOD: Anterior, superficial masseter muscle biopsies were taken from 29 patients (15 long faces (LFS), 10 short faces (SFS) and 4 normal controls as confirmed by cephalometric analysis) and frozen in thawing isopentane. Immunohistochemical staining of the cryostat sections employed antibodies to fibronectin (FN), a major component of the ECM, and the relative FN levels were measured using a computerised image analysis system. RNA was extracted from the samples and reverse transcribed to cDNA, prior to amplification by polymerase chain reaction (RT-PCR) using TIMP-1 gene specific primer pairs.
RESULTS: Fibronectin was present in both the perimysium and endomysium of all samples. Measurement of the relative FN levels revealed highly significant associations with specific cephalometric variables representing vertical facial form. The highest levels were expressed in the LFS group, followed by the normal controls and the lowest levels expressed in the SFS patients. Furthermore, as determined by RT-PCR, the message for TIMP-1 was expressed in the normal masseter muscles suggesting that the accumulation of FN associated with vertical facial deformities is a dynamic process and not simply an increased expression of fibronectin.
CONCLUSIONS: These results suggest that although there is no difference in the location of FN within the masseter muscle of subjects with vertical facial deformities, there is a marked accumulation in long face deformities which is likely to play a significant role in the pathophysiology of these disorders.

Rampoldi E, Meola G, Conti A, Velicogna M, Narizza L 1986 A comparative analysis of collagen III, IV, laminin and fibronectin in Duchenne muscular dystrophy biopsies and cell cultures. European Journal of Cell Biology 42: 27–34

48 AN ANALYSIS OF THE GROWTH OF THE FACE IN A LONGITUDINAL AND A CROSS-SECTIONAL STUDY OF A GROUP OF MALES FROM 8–18 YEARS OF AGE

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AIM: To assess the three-dimensional growth of the face in a group of males from 8–18 years of age.

SUBJECTS AND METHOD: Longitudinal growth in two males and cross-sectional growth of 60 males was studied. The cross-sectional study included ten males in each age group at 8, 10, 12, 14, 16 and 18 years. The face of each patient was scanned using an optical surface scanner and the 60,000 co-ordinates stored for analysis. The average face for each group was computed and compared with the following age group by superimposing over the eyes and forehead the two recorded scans, and the changes were displayed in colour. The profiles across the face at the eyes, base of the nose, the mouth and down the face at the midline together with the inner and outer canthus of the eyes, were analysed. The curvature analysis of the profiles used the zero crossings to determine the point at which the curves change from convex to concave. The parts of the curves were then analysed and compared.
RESULTS: These show that the face grew in width and height and that the lips and nose became more prominent. There were also considerable changes in the curves of the face, especially during the growth spurt.
CONCLUSIONS: Optical surface scanning is a valuable method for the analysis of three-dimensional growth of the face.

49 DISCONTINUOUS FORCES CAUSE LESS EXTENSIVE ROOT RESORPTION THAN CONTINUOUS FORCES

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AIM: Root resorption is one of the adverse side-effects of orthodontic therapy. Its severity is often related to force magnitude and duration of force application. The aim of this study was to quantify root resorption after continuous or discontinuous application of different forces, using the beagle dog as an experimental model.
MATERIALS AND METHOD: In 10 young adult beagles the mandibular third premolars were extracted and orthodontic appliances for bodily distal movement of the second premolars were placed after three months. Continuous (24 h/day) or discontinuous (16 h/day) forces ranging from 10 to 200 cN were applied by elastics or closed coil springs. Four to 100 days after the start of force application, the dogs were sacrificed for histological and histomorphometric evaluation. Surface areas, depths, and relative lengths of the resorption areas were determined for each root. ANOVA and Tukey's multiple comparisons tests were used for evaluation of the influences of force magnitude, duration of application, and force regime on the amount of root resorption.
RESULTS: As early as 7 days after force application, small localized resorption areas were present on several root surfaces in all groups. These areas seemed to increase in dimension during the experimental period. However, due to large individual differences, no statistically significant influence of the duration of force application or force magnitude could be established. The force regime, however, appeared to have a significant influence: discontinuous forces induced less root resorption than continuous forces. In the most severe cases about 40 per cent of the width from cementum to pulp had been resorbed over about one-third of the root length.
CONCLUSION: Under the given circumstances discontinuous forces cause less extensive root resorption than continuous force regimes.

50 THE MANDIBULAR OPENING-CLOSING PATH AND VERTICAL CRANIOFACIAL MORPHOLOGY

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AIM: To analyse the slope and magnitude of the mandibular opening-closing path, and to assess its relationship to vertical craniofacial morphology.
SUBJECTS: Forty subjects (23 males, 17 females) aged 22 to 31 years of age without craniomandibular functional disorders.
METHODS: Lateral cephalograms were taken and the Frankfort–Horizontal–Mandibular Plane angle (FH-MP) was measured as an indicator of vertical craniofacial morphology. Mandibular movements (incisal point) were recorded by means of a kinesiograph. During examination the subjects sat in an upright position with their head firm and Camper's plane (a horizontal plane passing through the tragale of each ear and through the subnasale) parallel to the floor. They performed three deliberate maximum opening and closing jaw movements along their habitual path. Maximum jaw opening (MO) was measured in the sagittal plane. The opening-closing angle (OCA) between the horizontal plane and the sagittal path of movements was calculated for the first 20 mm of vertical jaw displacement. Duplicate measurements between-sessions (1 week) were performed. Pearson's product-moment correlation supplemented by linear regression and Student's t-test were used for statistical analysis.
RESULTS: The method error from duplicate recordings was 3.6 per cent for OCA and 2.9 per cent for MO. OCA did not differ ($P>0.05$) between males (61.2 ± 7.3 degrees) and females ($59.3+9$ degrees). OCA showed highly significant negative correlation with FH-MP. The regression line was: $OCA=-0.72(FH\text{-}MP)+78.3$ ($r=-0.657$; $P<0.001$). MO was significantly ($P\leq0.05$) greater in males ($49.2\text{ mm}\pm4$) than in females ($46.7\text{ mm}\pm4.5$); moreover MO was negatively correlated to FH–MP both in males and females subjects ($r=-0.446$ and $r=-0.498$; $P<0.05$).
CONCLUSION: The slope and magnitude of functional jaw movements are related to vertical craniofacial morphology; short face subjects exhibit a larger and more vertical path of mandibular movement than long face subjects.

These differences could be geometrically explained. Research and clinical implications will be illustrated.

51 DISTRACTION OF THE MANDIBLE AND CRANIOFACIAL SKELETON

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(KEYNOTE ADDRESS)

Distraction osteogenesis was pioneered by Professor Ilizarov of Russia who practised the technique extensively in the reconstruction of various defects and deformities of the long bones of the upper and lower extremities.

Based on his contributions, a series of experiments were undertaken at NYU Medical Centre using the technique on the membranous bones of the canine craniofacial skeleton. In a preliminary experiment (Karp *et al.*, 1990), an osteotomy was made at the angle of the mandible on one side. A mini lengthening device was then applied across the osteotomy and distraction initiated at post-operative day 7. It was demonstrated in dogs that the technique was effective in lengthening the mandible and development of a crossbite with radiographic findings of new bone formation.

A serial study was also undertaken at the distraction site which showed that there were four temporal zones of distraction Karp *et al.* (1992). The first (fibrous tissue) was characterised by collagen laid in a linear fashion, parallel to the long axis of the distracted bone. In the second (bone formation) osteoblasts were demonstrated in close contact with the fibroblasts in the collagen. In the third (bone remodelling) there was evidence of newly formed bone by the appearance of multi-nucleated osteoclasts. Finally, in the fourth (mature bone) there was formation of dense, compact bone, indistinguishable in appearance.

Based on these experiments in the dog, a clinical programme of distraction was carried out of the human mandible (McCarthy *et al.*, 1992). Since that time the technique has been applied on 19 males and 17 females. The average age the time of distraction was 5.9 years (range 1.5 to 21 years). The technique was applied unilaterally in 23 patients and bilaterally in 13 patients. The average amount of distraction was 23 mm. The diagnoses were craniofacial microsomia, developmental micrognathia, Treacher Collins syndrome and Nager syndrome. The results indicated a multidimensional type of augmentation of the mandible, not achieved by traditional orthognathic techniques. There are two unique properties of distraction osteogenesis. The technique is applied in a gradual fashion (1 mm per day) and there is concomitant lengthening of the associated soft tissues including muscles, nerves and skin (functional matrix). Consequently in longitudinal follow-up studies no evidence of relapse has been documented, a finding which stands in contrast to the experience in traditional mandibular advancement.

Experiments have also been conducted on distraction of other components of the craniofacial skeleton. Osteotomies were made at two points in the zygomatic arch in dogs (Glat *et al.*, 1994). A specially designed distraction device was placed on the adjacent components of the zygomatic complex and the intervening osteotomized segment was distracted at right angles to the long axis of the bone, which proved that the membranous bones of the craniofacial skeleton can be distracted at right angles to the long axis and that the zygomatic complex is amenable to surgical distraction.

In immature dogs, distraction devices were placed across the nasofrontal and zygomatico-maxillary sutures without osteotomies (Staffenberg *et al.*, 1995). Active distraction was commenced on the day following surgery and evidence of bilateral enopthalmos and anterior crossbite was demonstrated. These experiments showed that the entire midface complex is amenable to distraction and that in immature animals osteotomies are not necessary. In a follow-up canine experiment (McCarthy, 1996) it has been shown that Le Fort III osteotomy could be performed through limited incisions via an endoscope, and distraction devices applied. The osteotomies were not completed through the medial orbital wall and nasal bones in order to reduce blood loss and obviate the need for blood transfusions. These experiments documented that Le Fort III osteotomies could be performed through small incisions via the endoscope without attendant wide dissection and blood loss. These are techniques that will eventually be applied to humans, significantly reducing the length of hospitalisation and operating time.

Distraction osteogenesis is a new technique which holds considerable promise in simplifying craniofacial surgical reconstruction, in reducing the length of hospitalisation and attendant morbidity and in giving superior surgical results with reduced relapse rates.

Karp N S, Thorne C H, McCarthy J G, Sissons H A. 1990 Bone lengthening in the craniofacial skeleton. Am. Plast, Surg., 24: 231

Karp N S, McCarthy J G, Schreiber J S *et al.* 1992 Membranous bone lengthening: A serial histologic study. Am. Plast, Surg., 29: 2

McCarthy J G, Schreiber J G, Karp N S *et al.* 1992 Lengthening of the human Mandible by Gradual Distraction. Plast. Reconstr. Surg., 89: 1

Glat P M, Staffenberg D A, Karp N S, Holliday R A, McCarthy J G 1994 Multidimensional distraction osteogenesis: the canine zygoma. Plast. Reconstr. Surg., 94: 753

Staffenberg D A, Wood R J, McCarthy J G *et al.* 1995 Midface distraction or advancement in the canine without osteotomies. Am. Plast. Surg., 34: 512

McCarthy J G 1996 Unpublished data

52 AUTOTRANSPLANTATION OF PALATALLY IMPACTED MAXILLARY CANINES — A 10-YEAR REVIEW

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AIM: To carry out a survey of transplanted maxillary canines completed over a 10-year period in order to clarify the prognosis of this procedure performed at a single hospital department.

SUBJECTS AND METHOD: A total of 50 patients (34 female and 16 male subjects) with 63 autotransplanted canines (37 unilateral and 13 bilateral cases) were observed for a period of between 1 to 10 years (mean 3.98 years). Transplanted canines less than a year out of retention were not included in the study. Only palatally impacted maxillary canines were investigated. All the transplants were carried out by the same surgeon under in-patient endotracheal anaesthesia using identical surgical and fixation techniques. The surgical technique used will be described in full and is seen to differ in certain important respects from those previously described in the literature. In the present series, endodontic therapy was not performed post-surgically unless clinical and/or radiographic evidence revealed the need for intervention.
RESULTS: During the observation period (range 1–10.7 years), minor resorptive lesions were noted in a few subjects resulting in the loss of only 1 (1.6 per cent) of the 63 transplanted teeth. Eight cases (12.7 per cent) required endodontic therapy to arrest internal pulp resorption (2 cases), or lateral/apical external inflammatory resorption (6 cases). Forty-seven (75 per cent) of canines exhibited a completely intact periodontal ligament space radiographically. The remainder were found to have small, localised areas of replacement-type root resorption which were asymptomatic and non-progressive in nature. Positive pulp vitality tests were recorded for 41 per cent of the transplanted sample. A strong association between impacted palatal canines and absent or peg-shaped permanent lateral incisors was confirmed.
CONCLUSIONS: The findings of this review compare favourably with other published reports. Canine transplantation is an operator-sensitive procedure that has a good long-term prognosis, provided that a precise surgical technique is used. Some possible differences in the standardised approach used, which may have some beneficial effects, are mentioned and compared with past reported methods. The need for regular clinical and radiographic monitoring is discussed.

53 TOOTH MOVEMENTS IN THE MANDIBLE DURING BASS THERAPY

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AIM: The purpose of this study was to analyse movements of lower molars and incisors during the initial six months of treatment with the Bass appliance.
SUBJECTS: The study comprised 16 boys with severe Class II division 1 malocclusions consecutively treated with the Bass appliance. The age at the start of treatment varied from 8.9 to 16.1 years.
METHODS: Treatment was performed according to a standardized procedure described earlier. No extractions of primary or permanent teeth were carried out during the observation period. A fixed appliance was not used in the lower jaw. Recordings with study models and lateral cephalograms were analysed from six months pre-treatment, at start, and six months post-treatment. Sagittal changes in the position of the molars and incisors were studied in relation to stable structures in the mandible by superimposition. The error of measurement did not exceed 0.5 mm. Measurements on the dental casts were made with a digital calliper to the nearest 0.1 mm.
RESULTS: The space decreased 0.7 mm during the observation period and increased during the six months of treatment, 1.7 mm on the buccal sides and 0.4 mm in the anterior region, and the first molars were uprighted 2.2 degrees on average. A large individual variation was noted.
CONCLUSION: During treatment with the Bass appliance space gain can be anticipated.

54 PERIODONTAL AND OCCLUSAL STATUS AFTER ORTHODONTIC EXTRACTION OF SECOND MOLARS

S L Orton-Gibbs, H S Orton, Guy's Hospital, London, and Mayday University Hospital, Surrey, U.K.

AIMS: To establish whether periodontal health and functional occlusion are satisfactory after orthodontic treatment involving extraction of second molars.
METHOD: Thirty-seven patients (25 females, 12 males) who had second molars extracted before, during, or after orthodontic treatment and whose third molars were in occlusion were recalled.

Time since 7's extracted	$\times = 8.4$ years (range: 3.6–17.6 years)
Age at examination	$\times = 21.9$ years (range: 16.1–30.5 years)
Time post retention	$\times = 4.7$ years (range: still in retention–15.4 years)

The clinical examination involved assessment of:
1. Functional occlusion-anterior guidance in protrusion and left and right excursions
2. Plaque index (Silness and Löe)
3. Bleeding on probing
4. Attachment loss i.e. probing depth plus gingival recession

Assessment 2,3 & 4 on buccal and lingual surfaces of

$$\frac{86\ 21/12\ 68}{86\ 21/12\ 68}$$

RESULTS: Occlusion on the working sides during left and right lateral excursions: 63 per cent canine guidance. The remaining patients had group function usually with guidance from the canines and premolars. None had undesirable guidance from first or third molars alone. Of 74 pairs of third molars examined there was only one non-working side interference (recently erupted lower third molar). Protrusion: 34 patients had posterior disclusion. The 3 patients who did not, started treatment with anterior open bites and had incomplete overbites post-retention.
Plaque index (0–3): No patient had a plaque score of 3 (abundance of plaque). Six patients had a plaque score of 2 (visible plaque) on the buccal surfaces of the upper 8's, and 4 patients on the lingual surfaces of the lower third molars. Bleeding on probing: 1.6 per cent of sites. 68

contacts and the lower laterals lingually were the areas invariably affected in the few sites with bleeding on probing. Attachment loss: 2,238 sites clinically healthy (i.e. less than 3 mm loss of attachment). Two sites in one patient had 4 mm loss of attachment at the 861/ contact.
CONCLUSIONS:
1. The third permanent molars invariably erupt into a position that maintains a good functional occlusion.
2. The periodontal health of the sample was excellent.
3. This study would seem to confirm that patient's oral hygiene and susceptibility are the important factors for any long-term development of periodontal disease.

55 SONOGRAPHY OF THE HAND FOR THE ASSESSMENT OF SKELETAL MATURITY

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The routine use of hand-wrist radiographs for the assessment of skeletal maturity has been questioned in view of the radiation exposure.
AIM: To present and evaluate a new method for judging skeletal development utilizing sonographic imaging.
SUBJECTS: Fifty orthodontic patients aged 8 16 years were surveyed.
METHOD: Using both a sonographic and radiographic approach the epiphysial development of the middle phalanx of the third finger was analysed according to the method of Hägg and Taranger (1980).
RESULTS: When comparing the findings of the two imaging techniques the reliability and validity of the sonographic method was found to be high.
CONCLUSION: In clinical orthodontics sonographic imaging of the hand could be a useful method for the assessment of skeletal maturity.

Hägg U, Taranger J 1980 Skeletal stages of the hand and wrist as indicators of the pubertal growth spurt. Acta Odontologica Scandinavica 38: 187–200

56 A CEPHALOMETRIC STUDY OF 100 CONSECUTIVE PATIENTS TREATED WITH THE HERBST APPLIANCE AND FOLLOWED UNTIL CESSATION OF GROWTH

H U Paulsen, Department of Orthodontics, Copenhagen Municipal Dental Health Service, Denmark

AIM: It has previously been shown that condylar morphology changes during Herbst treatment by bone modelling, frequently in a distocranial direction (Paulsen, 1994). The aim of the present study was to investigate morphological changes in the profiles of patients treated with the Herbst appliance, during and after treatment.
SUBJECTS AND METHOD One hundred patients (64 girls and 36 boys) treated with the Herbst appliance in the period of puberty to adulthood. Changes in the profiles of patients were examined on lateral cephalograms taken in occlusion and during maximal opening using Björk's method. Skeletal ages were calculated using the Tanner-Whitehouse-2 (TW2) method, modified for the Danish population. Radiographs were taken before and after Herbst treatment, and yearly thereafter until growth had ceased. Lateral cephalograms and images of dental arches were digitized with a subsequent computer data analysis using a special computer program (TIOPS™).
RESULTS: During treatment the analysis revealed a significant increase in the length of the mandible (pgn–cd) and in ramus height (tgo–cd). The gonion angle (ML/RL) had opened. The mandibular incisors and alveolar process had tilted forward. The changes were most distinct in younger individuals and more pronounced in boys than in girls, but also registered in persons at adulthood. The mandible showed total forward rotation. However, the treatment elicited changes in intramatrix rotation, as previously seen at the condyles. After treatment, the mandibular incisors and alveolar process recovered partly in balance with forward rotation of the mandible and original interincisal angle. The gonion angle partly recovered. Treatment effects were stable if growth had ceased.
CONCLUSION: The main treatment effect can be described as growth modification. Treatment induced growth and rotation of the mandible with compensatory bone formation to adapt to the new position of the mandible. The effects were diminished if the occlusion was not retained until growth had ceased.

Paulsen H U 1994 Herbst treatment. The effect on TMJ condyles of 100 cases treated in the period of puberty to adulthood. European Journal of Orthodontics 16: 345 (Abstract)

57 PREVALENCE OF DENTAL ANOMALIES ASSOCIATED WITH MAXILLARY CANINE MALPOSITION

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Biological interrelationships are becoming evident for some human dental abnormalities that occur together more frequently than would be expected by chance alone. These related anomalies include variations in tooth number, size and eruption, chronology and sequencing. Malposition of teeth has received little study as a potential covariable in this pattern of association.
AIM: To study frequencies and patterns of dental anomalies occurring in persons with specific maxillary canine ectopia.
SUBJECTS AND METHOD: Two samples were collected of non-syndromic subjects from North America and Europe possessing certain positional anomalies of maxillary canine teeth: maxillary canine-first premolar transposition (Mx.C.P1, n = 43) and palatal displacement of the maxillary

canine (PDC, n=58). Panoral radiographic analysis was utilized to identify tooth agenesis. Conical crown-size reduction (peg-shape) of the maxillary lateral incisor (12) was identified by direct observation.
RESULTS: In the Mx.C.P1 and PDC samples, elevated prevalence was observed for each of the studied anomalies of tooth number and size. Tooth agenesis (excluding M3) was found in 37 per cent (16) of 43 Mx.C.P1 subjects and in 17 per cent (10) of 58 PDC subjects. Peg-shaped 12 accompanied Mx.C.P1 in 16 per cent (7) of 43 subjects and was observed in 17 per cent (10) of 58 PDC subjects. Compared with normal prevalence data, the increases in occurrence of tooth agenesis and peg-shaped 12 were highly statistically significant.
CONCLUSIONS: The results are consistent with the hypothesis that the anomalies of Mx.C.P1, PDC, tooth agenesis and tooth-size reduction are biological covariables related probably through shared genetic mechanisms.

58 EFFECTIVENESS OF ORTHODONTIC TREATMENT: A PROSPECTIVE CLINICAL TRIAL

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AIMS: In orthodontics prospective clinical trials to evaluate treatment modalities are rare. At the University of Nijmegen (The Netherlands) a multi-practice prospective clinical trial is currently under way to evaluate effects and results of treatment with a fully programmed edgewise appliance (FPA; Roth prescription) compared with a partially programmed appliance (PPA).
SUBJECTS AND METHOD: One-hundred and forty nine Class II patients entered the trial and were allocated to 11 orthodontists. After records were taken and a treatment plan formulated, the type of fixed appliance was chosen by a computer using 11 criteria. During treatment several records were taken. The patient follow-up lasted until the end of active treatment. At the end of active treatment the effectiveness of both treatment modalities e.g. treatment duration, chairtime, patient satisfaction, root resorption and treatment results were compared. In this paper the treatment results will be reported. The weighted PAR Index (British validation) was used to record the dental alignment and occlusion pre- and post-treatment on dental casts. The scores of 134 patients (nFPA=67, nPPA=67) were evaluated using ANOVA.
RESULTS: The mean pre-treatment score for the FPA group was 28.7 ± 8.7 and for the PPA group 30.9 ± 9.1. The mean post-treatment score was 4.0 ± 3.5 and 4.0 ± 2.6, respectively. The mean percentage PAR score reduction was 84.7 ± 15.3 and 85.6 ± 9.4, respectively. ANOVA showed no effect on the effectiveness of treatment with either appliance. However, there were significant differences between the post-treatment scores of the participating orthodontists ($P=0.02$) and percentage reduction ($P=0.01$). No interaction was found between appliance and orthodontist.
CONCLUSION: This study shows that equally adequate treatment results can be achieved with a partly programmed and a fully programmed fixed appliance therapy. Treatment results, however, are operator dependent.

59 IMPORTANCE OF CARTILAGINOUS PROTEOGLYCANS FOR MANDIBULAR CONDYLAR GROWTH PROCESSES

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AIMS: The large proteoglycans of mandibular condylar cartilage were investigated with respect to their immunological identity and their age-dependent distribution in different histological layers. This provides new information on how large proteoglycans are involved in the regulation of mandibular condylar growth processes influenced by altered mechanical loading, and developmental length of the mandible.
MATERIALS AND METHOD: After isolation by dissociative extraction and CsCl density gradient centrifugation, the large proteoglycans of the mandibular condylar cartilage of 20 juvenile domestic pigs were characterised by gelelectrophoresis and immunoblotting with polyclonal antibodies against aggrecan and versican. The distribution of these proteoglycans was studied on cryosections of neonatal (until 2 weeks post partum [p.p.]), juvenile (9–12 months p.p.) and adult (more than 24 months) condyles by immunohistochemistry.
RESULTS: The mandibular cartilage contains a large proteoglycan immunorelated to aggrecan which gives a protein core of 440 kD after enzymatic deglycosylation. Furthermore, the mandibular cartilage contains another large proteoglycan with a protein core of 550 kD immunorelated to the fibroblast like versican, which has never been described in other articular cartilages. By immunohistochemistry the aggrecan reactivity was found at all ages with increased staining in an inferior direction. The versican reactivity was predominantly detected in the superficial fibrocartilaginous layers of juvenile and adult condyles.
CONCLUSIONS: The mandibular cartilage expresses specific large proteoglycans for parallel realisation of articular movement and growth adaptation. Aggrecan is mainly the 'shock absorber' molecule during joint movement, necessary at all ages. Versican, also described in limb buds before chondrogenesis, possibly controls the formation of mesenchymal cell condensations via its 'cell-substrate antiadhesive' properties as a prerequisite for cell proliferation and differentiation (Shinomura *et al.*, 1992). Thus versican concentration seems to be an indirect measure for the growth potency of the mandibular condylar cartilage.

Shinomura T, Nishida Y, Kimata K 1992 In: Kuttner K E *et al.* (eds) Articular cartilage and osteoarthritis Raven Press Ltd., New York, pp. 35–43

60 MAGNET RESONANCE IMAGING AND MANUAL FUNCTIONAL ANALYSIS FINDINGS IN THE TMJ AFTER HERBST TREATMENT

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AIM: To assess the long-term effects of the Herbst appliance on the temporomandibular joint (TMJ).
SUBJECTS AND METHOD: In 20 patients who had completed Herbst treatment at least 2 years earlier, magnetic resonance imaging (MRI) of the left and right TMJ was performed. The results of the MRI scans were compared with the clinical findings assessed by means of Manual Functional Analysis (MFA) of the joints.
RESULTS: No subject had a history of pain or limitation. Three subjects had a previous history of temporomandibular joint dysfunction (TMD) with clicking of one joint. At the follow-up two of these patients were clinically diagnosed as having a clicking of the lateral ligament (the MRI showed a normal disc/condyle relationship). The third patient had an anterior disc displacement with reduction. He exhibited a dual bite and bruxism. In three patients without previous history of TMD, the MFA revealed a capsulitis of the bilaminar zone which was either due to bruxism, dysfunction, or a dual bite. The MRI's of the subjectively and clinically asymptomatic patients did not show any irregularities.
CONCLUSION: In general Herbst treatment does not seem to have any adverse long-term effects on the TMJ. However, an unstable occlusion (dual bite) after Herbst therapy could be a predisposing factor for TMD.

61 ORTHODONTIC ROOT RESORPTION AND TRAUMATISATION OF THE INFERIOR ALVEOLAR NERVE AFTER ORTHOGNATHIC SURGERY

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AIM: Root resorption is a frequent finding and the result of mechanical traumatisation during orthodontic treatment, and mechanical traumatisation of the inferior alveolar nerve is a frequent finding in patients after orthognathic surgery. The aim of the present investigation was to evaluate the frequency of root resorption in a sample of patients with and without signs of a surgical traumatisation of the inferior alveolar nerve before, during, and after orthodontic treatment.
MATERIALS AND METHOD: In a retrospective study the treatment and radiographic records of 29 male and 66 female patients having undergone orthognathic surgery to the mandible were evaluated. The records included panoramic radiographs before orthodontic treatment, directly before and after orthognathic surgery, at the time of removal of the osteosynthesis material and at the end of the orthodontic treatment. The frequency and extent of root resorption of 1,077 teeth was estimated with a root resorption index and statistically analysed for patients with ($n=33$) and without ($n=62$) signs of surgical traumatisation of the inferior alveolar nerve.
RESULTS: The results demonstrate a clear time correlation of the frequency and extent of visible root resorptions in patients with and without surgical traumatisation of the inferior alveolar nerve. Patients with surgical nerve traumatisation showed a significant increase of root resorption between the time of orthognathic surgery and the removal of the osteosynthesis material.
CONCLUSIONS: The results suggest an increased susceptibility for root resorption during orthodontic treatment for patients with surgical traumatisation of the inferior alveolar nerve, which might be caused by a deterioration of the bite force control, or a decreased neuronal control of osteoclastic activity.

62 VERTICAL CHANGES IN TREATED AND UNTREATED SUBJECTS WITH CLASS II DIVISION 1 MALOCCLUSIONS

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AIM: The purpose of this retrospective study was to investigate the long-term vertical changes in girls with treated and untreated Class II division 1 malocclusions.
SUBJECTS AND METHODS: One treated group ($n=9$, mean age 11.72 years, SD 1.74), and the other untreated ($n=8$, mean age 11.88 years, SD 2.20). Ten dimensions were measured on cephalometric radiographs taken at the initial consultation, at the end of treatment and, on average, either 12 years (Treatment group) or 8 years (Control group) after the initial visit. Recall records of the girls in the Treatment group were taken at least 5 years post-retention.
RESULTS: At the outset UI/ANS-PNS, overjet (treatment group, 11.44 mm; control group, 8.65 mm), and the height of the lower incisors above the functional occlusal plane were significantly greater ($P<0.05$) in the treatment group. During the course of the study the anterior and posterior face heights, and upper and lower molar heights increased significantly ($P<0.05$) in both groups. Overjet reduced from 8.65 mm to 6.95 mm in the control group, and relapsed from 3.57 mm at the end of treatment to 5.8 mm at the recall visit in the treatment group. At the conclusion of the study anterior face height was significantly greater ($P<0.05$), and SNA and SNB were significantly smaller ($P<0.05$) in the Treatment group. There were, however, no significant differences between the control and treatment groups in UI/ANS-PNS, overjet, upper and lower first molar heights, or posterior face height.
CONCLUSIONS: The significant difference in anterior face height is attributed to the shorter period between the initial and recall records in the control group, and to a small difference between the groups at the outset (treatment group > control group) rather than an increase in face height induced by the appliances. It would appear that orthodontic

treatment has no permanent effect on either the vertical height of the face, or the vertical heights of the molars, in girls with Class II division 1 malocclusions.

63 EUROPEAN UNION CLEFT LIP AND PALATE PROGRAMME

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(KEYNOTE ADDRESS)

The European Union is funding a three-year programme intended to (1) develop a network of cleft teams throughout the European Community, (2) define minimum standards of care, (3) agree common outcome measures, (4) promote intercentre comparison studies and (5) stimulate multicentre randomised control trials.

A great deal of collaborative work will be necessary in the years ahead if cleft lip and palate care is to become 'evidence based'. Intercentre comparisons using rigorous entry criteria and standardised data collection and analyses, offer great opportunities for teams to compare their clinical standards and the burden of care on patients imposed by their protocols. These studies however are not suitable for comparing individual components of care such as surgical or orthodontic technique because of biases created by differing levels of surgical skill, or other variations in protocols. Randomised control trials are designed to overcome these biases and a small number of multicentre European trials are in progress.

This presentation will focus on opportunities for teams to become members of the European Union's network and take advantage of the economic resources available to support collaborative work.

64 ORTHODONTIC TOOTH MOVEMENT AND THE ROLE OF THE MICROVASCULAR BED OF THE PERIODONTAL LIGAMENT

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(KEYNOTE ADDRESS)

Without the presence of the periodontal ligament (PDL) microvascular bed (MVB), orthodontic tooth movement could not occur. A feature of this vascular system is its essentially venous structure that hold over 90 per cent of the PDL blood volume.

The PDL blood system provides the source reservoir for the exchange of metabolites and cells across the endothelium between the vascular and connective tissue compartments. This endothelium is an active structure in the physiological exchange mechanisms, generating an array of regulator molecules to control both internal and external changes.

Orthodontic tooth movement can reposition a tooth 1 mm per month. Consequently the total PDL structure must relocate over a distance of more than twice its width each 30 days of treatment. Clearly the associated MVB reconstitution must involve rapid angiogenesis.

In vitro model systems provide growth of endothelial cells under conditions that mimic an *in vivo* situation. Angiogenesis in the laboratory provides an insight into the formation of lumens and the anastomoses of adjacent sprouts to form vascular loops and planar networks.

Some morphological, functional, and ageing features of the endothelium will be discussed in this presentation.

65 VISUALLY JUDGED JAW RELATIONSHIPS AS A REGRESSION OF CEPHALOMETRIC VARIABLES

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AIMS: To determine a linear combination of cephalometric variables which approximates to a visual understanding of patients' skeletal jaw base relationships as judged by experienced orthodontists.

SUBJECTS AND METHOD: Sixty-six adult females were selected. Skeletal jaw base relationships in the sagittal direction were visually judged by 10 orthodontists based on patients' facial and intraoral photographs, lateral cephalograms and their tracings, without identification of the sella and nasion points. The ANB difference angle and the distance between points A and B projected onto the palatal plane were measured on the cephalograms independently. Wits, JYD angle and McNamara's analyses were also made. Simple and multiple regression analyses were performed between the visual judgment as a dependent variable, and the cephalometric variables as independent variables.

RESULTS: The visual judgment correlated with the A-B distance ($Ad.R^2 = .835$), ANB ($Ad.R^2 = .821$), McNamara ($Ad.R^2 = .681$), JYD angle ($Ad.R^2 = .682$) and Wits ($Ad.R^2 = .621$), respectively. Increased adjusted R^2 were determined between the visual judgment and linear combinations of AB/PP, SNPP and SNMP ($Ad.R^2 = .888$) and ANB, SN, SNMP and Ar-Me ($Ad.R^2 = .875$), respectively.

CONCLUSIONS: Skeletal sagittal jaw relationship visually evaluated by orthodontists is explained by a linear combination of specific cephalometric variables. The regressions thus determined can be incorporated in an algorithm for automatic classification of skeletal jaw relationship which optimizes experienced orthodontists' views.

66 EFFECT OF ELECTRIC VERSUS MANUAL TOOTHBRUSHES ON PLAQUE REMOVAL AND PERIODONTAL STATUS DURING ORTHODONTIC TREATMENT

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AIM: Orthodontic patients, especially adolescents, often show ineffective plaque control because of the difficulty of oral hygiene when fixed orthodontic appliances are in place. The inherent retentive areas produced by the presence of

orthodontic bands, brackets and archwires provide additional opportunities for the collection and retention of food and debris and for the adhesion of dental plaque microorganisms. The increased supply of substrates supports luxuriant bacterial growth and accounts for the increased concentration for bacteria in the plaque. Orthodontic appliances also protect the dental plaque from the mechanical action of brushing and mastication. The aim of this study was to compare the effectiveness of three different types of electric toothbrush, i.e. Interplak, Philips and Rotadent, with a manual multi-tufted toothbrush (Blend-a-Med), in removing supragingival plaque and in preventing the development of gingivitis in adolescent patients with fixed orthodontic appliances.
SUBJECTS AND METHOD: A single blind, cross-over, clinical trial was carried out in 36 adolescent patients, randomly divided into four equal groups. Every group tested each type of toothbrush in a different order. Plaque and gingival scores were recorded at baseline and after 1 and 2 months of the test period. All patients received a professional prophylaxis after each clinical evaluation, except within the test period. The analysis of the date was performed using the non-parametric Friedman's test.
RESULTS: The results showed, for all parameters, that the manual toothbrush was the most effective. Of the electric toothbrushes tested, Philips seemed to be slightly better than the Interplak, whereas Rotadent was the least effective.

67 MULTI-CENTRE PSYCHOLOGICAL OUTCOMES FOR PATIENTS WITH CLEFT LIP AND PALATE

S R Turner, N Rumsey*, J R Sandy, Department of Child Dental Health, University of Bristol, and *School of Psychology, University of the West of England, U.K.

AIMS: To determine how cleft affected patients and their parents perceive the delivery of treatment, to identify areas that need improvement, and to assess the psychological status of cleft affected patients and their parents.
SUBJECTS AND METHOD: Questionnaires were developed for patients aged 10, 15 and 20 years, as well as for parents of 1, 5, 10, and 15 year-old patients. In all, 112 patients and 130 parents were interviewed.
RESULTS: Overall, 88 per cent of patients and 88 per cent of parents were satisfied with their care. However, 60 per cent of parents and 37 per cent of patients suggested ways in which cleft care could be improved. Dissatisfaction was associated with poor communication between cleft specialists and families. Some 25 per cent of patients found difficulty in talking to, or understanding, the specialists. Seventy-four per cent of patients felt their self-esteem was low. Eight families received counselling for cleft related emotional problems. Parents did not agree with their children regarding their level of satisfaction with clinical outcome of cleft features, (e.g. kappa = 0.12, $P < 0.12$, for 'profile'). There was a positive correlation ($r = 0.43$, $P < 0.001$) between high levels of satisfaction for clinical outcome and good psychosocial adjustment. Thus dissatisfied patients may be 'at risk' for poor psychosocial adjustment. Those subjects who are well adjusted and express satisfaction with clinical results may do so despite poor clinical outcomes.
CONCLUSIONS: Despite high levels of satisfaction, cleft care in the United Kingdom may not be addressing all of the psychosocial needs of the families. Patients' views on planned treatment should be sought independently from those of their parents, as there was no agreement between the groups for their perceived satisfaction for clinical outcome.

68 GENETIC MODELLING OF DENTOFACIAL DATA FROM MONOZYGOTIC AND DIZYGOTIC TWINS

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AIM: The aim of this study was to determine the heritability of sagittal dentofacial characteristics by means of genetic modelling using modern twin methodology and statistical techniques.
MATERIALS AND METHOD: The lateral headplates of 33 monozygotic and 46 dizygotic twins were used. All twins belonged to the East Flanders Prospective Twin Survey (EFPTS). Criteria for their selection pertained to their age (between 10 and 14 years), their willingness to co-operate, and the absence of any orthodontic treatment. Nineteen linear and four angular dental and facial variables were selected. Statistical analysis was performed with the SAS®, Prelis®, and MX® programs.
RESULTS: The intra-observer reproducibility of the measurements was high for all linear variables (except one), but smaller for all the angular variables. Calculation of the heritabilities revealed higher values for the vertical (72 per cent) than for the horizontal (61 per cent) variables. Sex differences were found for the total anterior facial height, showing a higher genetic component for boys (91 per cent) than for girls (68 per cent). The impact of genes appeared to be high for the dental variables but was very low for the angular facial parameters. Dominant inheritance was found for one variable, namely mandibular corpus length. For all other characteristics, the genes acted in an additive manner.
CONCLUSIONS: The largest impact of genes on dentofacial variables seems to be in the vertical direction, with a sex difference for the anterior face height. For the dental variables and the vertical and horizontal parameters, the AE model (additive genes and environment) fitted the best. This was in contrast to the angular variables for which the specific environmental model (E) fitted the best. Dominant alleles appear to determine the mandibular corpus length. For this variable, the best fitting model was the ADE model (additive genes specific environment and dominant genes).

69 SIMULTANEOUS REMOVAL OF FIRST DECIDUOUS AND FIRST PERMANENT PREMOLARS

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The discrepancy between available and needed space for the permanent teeth can be so large that extractions are unavoidable. That holds particularly true for patients with small middle sections of the apical areas. It also applies to anterior sections positioned too far dorsally in the maxilla, where in the transitional period permanent canines can be positioned superior to the first premolars, or on top of the root of the lateral permanent incisors. A comparable situation can exists in the mandible. When these conditions are detected at an early stage, interceptive measures should be considered.

In such patients substantial improvement in the position of the permanent canine can be obtained by removing the first deciduous molar and its successor in the same session, shortly before the deciduous molar should have been exfoliated. Subsequently the canine can move in the direction where the crown of the first premolar was located and will attain a more favourable position prior to emergence.

Following the simultaneous removal, an overlapping of the lateral incisor will be eliminated by distal movement of the canine crown within the jaw. Subsequently the canine will emerge in a better position than when the first premolar is extracted after it emerges into the oral cavity. In the later circumstance the room created within the bone, or displacement of the canine, is considerably less as the root of the first premolar is much narrower than its crown. The canine will in the meantime also have erupted further.

The advocated method is more effective in the maxilla than in the mandible due to differences in size and location of the corresponding sections of the apical areas.

70 PALATAL BONE SUPPORT FOR ORTHODONTIC IMPLANT ANCHORAGE REINFORCEMENT: A RADIOLOGICAL STUDY

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AIM: To evaluate vertical bone support in the median palate using lateral cephalograms after insertion of orthodontic implant anchorage.

SUBJECTS AND METHOD: Orthosystem-fixtures (titanium screws 6 mm, implant body length, diameter 3.3 mm), 12 adult patients. One implant was inserted into the midsagittal palatal region of each patient for maximal skeletal anchorage. Lateral cephalograms were taken directly after insertion. The palatal complex and implants were traced. Analysis criteria were: measurement of implant angulation to the palatal planar-implant distance in relation to the radiologically detectable borders of the palatal complex, and assessment of any bony perforation to the nose during implant insertion procedure (probing of the drilled endosseous implant cavity).

RESULTS: All fixtures (n = 12) were installed into the anterior part of the median palate, angulation to the palatal plane: 44 to 60 degrees. In 7 patients (group I) the top of the implants projected below the radiologically detectable cranial border of the palatal complex (vertical distance between most cranial part of implant to cranial border of bone: mean = 1.6, min = 0.4, max = 2.7 mm). No bony perforation to the nose could be detected on probing. In 5 patients (group II) the top of the implants projected above the radiologically detectable cranial border of the palatal complex (vertical distance between cranial border of bone to most cranial part of the implants: mean = 1.3, min = 0.5, max = 2.1 mm). Probing of the endosseous implant cavity also revealed no perforation to the nose in any patient of this group.

CONCLUSIONS: Vertical bone support in the anterior part of the median palatal complex seems to be higher than shown on the cephalograms. Even if the most cranial part of the implant is located somewhat above the radiologically verifiable cranial border of the palatal complex (1–2 mm) no bony perforation to the nose is to be expected. These results are of some impact for treatment planning before orthodontic implant insertion (position/angulation length), and for avoidance of the potential risk of injuring the structural integrity of the nasal cavity.

71 SECULAR CHANGES IN MALOCCLUSION IN ADULT MALES

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AIM: It has been suggested that the development of secular changes in malocclusion has accelerated during the last 150 years in technologically advanced communities. The aim of this study was to quantify changes of various occlusal traits in males that occurred during this period.

MATERIALS AND METHOD: The material consisted of casts of the permanent dentitions in the skeletal remains of 94 19th century soldiers of Central-European origin (average age 21.5 years) and in 157 contemporary Austrian recruits (average age 23 years). All pairs of casts showed a stable and reproducible intercuspal position. Occlusal deviations were scored with the PAR Index. Statistical analysis comprised calculation of means, standard deviations, statistically significant intergroup differences (Mann-Whitney's *U*-test) and the error of the method.

RESULTS: It was found that the contemporary dentitions showed significantly higher malocclusion scores than the 19th century sample (weighted PAR Index 11.8 versus 6.6; $P < 0.001$). Marked differences between the groups were seen in the antero-posterior and transverse occlusal relationships in the buccal segments, due to the tendency towards Class II development and the higher frequency of crossbites in the present-day sample. Intra-arch alignment was significantly worse in the modern males, with the exception of the lower anterior segment. The 19th century sample showed significantly lower overjet and overbite scores.

CONCLUSION: The results show that secular changes in malocclusion have occurred during the last 150 years. It is suggested that the majority of the observed differences can be attributed to environmental factors.

72 INTERCEPTIVE ORTHODONTICS

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(KEYNOTE ADDRESS)

This address will explore the efficacy, cost effectiveness, and growth modification possibilities in interceptive orthodontic treatment procedures.

The Burlington Growth Centre was established in the mid 1950s to determine whether interceptive orthodontic treatment procedures applied to the total child population of the town could reduce the extent and need for future orthodontic treatment when all permanent teeth had erupted.

The results of this study of children aged 3–18 years of age will be reviewed. Modern evaluations of the effectiveness of orthodontic treatment in Class I, Class II and Class III malocclusions will be discussed.

73 THE PERIODONTAL INTERFACE: CLINICAL IMPLICATIONS OF RECENT ORTHODONTIC-PERIODONTAL RESEARCH FINDINGS

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(KEYNOTE ADDRESS)

This keynote lecture will discuss the practical consequences for orthodontists of recent research and new clinical advances in periodontology, as well as with regard to treatment planning, clinical management, aesthetic finishing, and optimal retention procedures and periods for adult orthodontic patients with different degrees of periodontal destruction.

In addition new information on specific aspects will be dealt with, such as:

- tooth movement into infrabony pockets
- tooth movement into constricted bone areas
- labial gingival recession
- interdental gingival recession
- minor surgery

For each topic, clinical advice will be presented with the aim of improving orthodontic treatment results for adult patients in whom different malocclusions are complicated by moderate or advanced periodontal break-down.

74 PATIENTS' ATTITUDES AND NON-COMPLIANCE IN ORTHODONTIC TREATMENT

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AIMS: The purpose of this study was to elucidate a potential relationship between patients' co-operation in orthodontic treatment and their attitudes, preferential values, perceptions and distress associated with the treatment. It was further intended to investigate the influence of personal circumstances on development of daily, weekly, or annual periodicity in favourable or poor co-operation.

SUBJECTS AND METHOD: A semi-standardized personal interview of 123 children and adolescents currently undergoing orthodontic treatment with removable appliances was carried out. The interview contained questions directed at elucidation of patients' attitudes towards the treatment and their understanding of its necessity and benefits, personal evaluation of their own co-operation, as well as analysis of personal circumstances and factors which may influence the compliance.

RESULTS: Sports, social activities, emotional disposition, daily routine and persons with whom the patients spent their time influenced the degree of compliance. Noticeable weekly and seasonal periodicity in compliance was detected. Self-reliance appeared to be more important for favourable compliance than reminding by parents or the orthodontist. As expected, treatment duration and patient's age influenced co-operation. Precise knowledge of instruction to wear the appliance significantly improved the compliance. Amongst various reasons for rejecting the appliance such as pain, discomfort, problems with speech and simple annoyance, the later was the only one which appeared to have a significant effect on co-operation. Compared with headgear and removable plates, functional appliances were reported by patients to be more difficult to adapt to.

CONCLUSIONS: Compliance with wearing removable orthodontic appliances varies considerably and depends on a number of factors primarily associated with the patient's attitude towards the treatment as well as on the patient's personal and social situation.

(The following abstract was omitted from those published previously. It was presented as a poster at the 71st Congress of the European Orthodontic Society)

75 PEAL/SHEAR BOND STRENGTH EVALUATION OF VARIOUS ORTHODONTIC BRACKETS AND ADHESIVES

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AIM: The aim of the study was to evaluate and compare the *in vitro* peel/shear bond strength (BS) of 22 bracket adhesives (BA) and 17 bracket bases (BB). Additionally, the effect of sandblasting metal BB on their BS was investigated.

MATERIALS AND METHOD: All BA were bonded to intact human premolars extracted for orthodontic reasons, using the same bracket (Miniature Twin, 3M Unitek, Monrovia, CA, USA). The retentive capacity of all BB was evaluated after bonding them to silane treated metal bars (STMB) using the same adhesive (Concise, 3M). After debonding the 12 metal BB tested were sandblasted (Microetcher, Danville Engineering Inc., Danville, CA, USA) with 90 μm aluminium oxide powder and rebonded to new STMB (ME). For both BA and BB samples, size was set at 12 and an Instron universal testing machine was used for the BS tests (samples inclination of 30 degrees). The 17 BB were examined morphologically with SEM. Statistical analysis included (M)ANOVA and Tukey's range test as well as Weibull analysis. Alpha was set at 0.01.

RESULTS: Mean bond strength values of BA, unsandblasted BB and sandblasted BB (ME) are given in MPa in ascending order. Bracket adhesives: Heliosit Orthodontic: 4.1; Insta-Bond NM: 5.0; Prestige: 5.3; APC Miniature Twin Precoated: 5.4; Insta-Bond VL: 5.4; System 1+: 5.8; Ideal: 6.1; Ortho-Loc: 6.1; Pulpdent OBA: 6.1; Right-on: 6.2; No-mix 30: 6.3; Force II: 6.4; Sequence: 6.5; Extend-A-Bond: 7.0; Unite: 7.2; UltraLight: 7.5; Spectrum: 8.2; Kurasper F: 8.3; Transbond XT: 8.4; Imperva Dual: 8.6; AccuBond: 8.7; Concise: 9.9; Bracket systems: Silkon-CeramalFlex:1.6; Mini Dyna Lock: 3.9 ME+6.3; Ormesh: 5.3 ME 5.8; 20/20m ceramic: 6.9; Optimesh: 7.4 ME- 5.8; Advant-edge: 8.4 ME 6.6; Transcend 6000: 8.8; Minature Twin: 8.9 ME+11.4; Standard Edgewise: 9.5 ME: 8.5; Accu Roth: 9.8 ME 9.1; Acu Arch MP: 10.1 ME 9.7; Micor Arch SM: 11.0 ME- 9.3; Masters: 11.4 ME- 7.3; Omni Arch: 11.8 ME- 9.4; Mini Masters: 13.0 ME- 8.4; Allure Accu Arch: 13.9.

CONCLUSIONS: Concise had the highest bond strength value of all BA but did not differ significantly from Spectrum, Kurasper F, Transbond XT, Imperva Dual and AccuBond. Of all BB, Allure Accu Arch significantly showed the highest bond strength. Microetching of metal BB increased (ME+), decreased (ME-) or had no effect (ME) on BS. SEM examination of BB provided additional explanatory evidence for the results of the BS test.