ABSTRACTS

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1 REPRODUCIBILITY OF COMPUTERIZED CEPHALOMETRIC ANALYSIS OF FRONTAL RADIOGRAPHS

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AIM: To determine the reproducibility of a computer-assisted frontal cephalometric analysis and to compare it with the reproducibility of traditional (manual) methods.
MATERIALS AND METHOD: Twenty standardized frontal radiographs, on which one observer made all cephalometric measurements twice, using both manual and computerized methods. Six parameters of Ricketts' frontal analysis incorporated into the software of Nemoceph 3.0 (Nemotec) were used.
RESULTS: Standard differences between repeated measurements of each of the six cephalometric parameters varied from 0.4 to 0.99 mm for the manual method. The computer-assisted method registered better values ranging from 0.3 to 0.89 mm. Ninety-five per cent of repeated assessments showed a deviation lower than 1 mm for both manual and computerized methods, but only for two of the cephalometric parameters.
CONCLUSIONS: The computer-assisted method is more reproducible than the manual method to determine all the cephalometric parameters analysed, except the angular measurement, maxillomandibular midline.

2 A COMPREHENSIVE EVALUATION OF CYANOACRYLATE ADHESIVE AS AN ORTHODONTIC BONDING AGENT

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AIM: (1) To evaluate shear bond strength of an ethyl-cyanoacrylate adhesive (Smart Bond) as an orthodontic bonding agent on metallic brackets compared with Concise orthodontic adhesive; (2) to evaluate its rebonding effects on debonded metallic brackets; and (3) to investigate the bonding effects on enamel using scanning electron microscopy (SEM).
MATERIAL AND METHODS: Sixty extracted maxillary first premolars maintained in a water bath at 37°C were equally divided according to the type, mode, and duration of bonded metallic brackets into the following groups. (1) Smart Bond under wet conditions for 24 hours; (2) Smart Bond under dry conditions for 24 hours; (3) Smart Bond under dry conditions for 10 minutes; (4) Control group: Concise orthodontic adhesive for 24 hours. A shear bond strength test was then undertaken. Ten teeth from each group were then rebonded using Smart Bond and tested after 24 hours. The remaining teeth in each group were prepared for SEM. For all groups, shear strength at debonding was measured using a universal testing machine. The adhesive remnant index was recorded for each group.
RESULTS: (1) The highest shear bond strength was in group 2; (2) the lowest shear bond strength was found in group 4; (3) testing rebonded brackets showed the highest shear bond strength for group 2 and the lowest for group 4; (4) SEM showed surface enamel with less scratches and deformation for the Smart Bond groups when compared with the Concise group.
CONCLUSION: When using ethyl-cyanoacrylate (Smart Bond) orthodontic adhesive: (1) enamel etching is recommended under dry conditions; (2) rebonding brackets with Smart Bond gives acceptable results especially in dry conditions whatever the original bonding agent; and (3) enamel exhibits an acceptable surface structure with Smart Bond orthodontic adhesive.

3 COMPARISON OF CRANIOFACIAL MORPHOLOGY IN UNILATERAL AND BILATERAL CLEFT LIP AND PALATE PATIENTS

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AIM: To compare the craniofacial morphology in unilateral and bilateral groups of cleft lip and palate (CLP) patients.
SUBJECTS AND METHOD: Thirty-seven unilateral (mean age 12.94 ± 1.11; 20 males, 17 females) and 12 bilateral (mean age 12.77 ± 0.61; eight males, four females) non-syndromic CLP patients were evaluated and compared with each other. The study was based on measurements of skeletal, dental, dentoalveolar, and soft tissue parameters on lateral cephalograms. All films were marked and digitized. A Student's *t*-test was performed for statistical comparison.
RESULTS: No significant differences were observed between the unilateral and bilateral CLP patients for the parameters evaluated. The bilateral group demonstrated a more skeletal Class III tendency, though not statistically significant.
CONCLUSION: Although the facial deformities are different in the two groups, no difference could be found in the soft tissue measurements. The similar craniofacial morphology could suggest similar treatment approaches in both groups.

4 DENTOSKELETAL TRANSVERSE FEATURES OF CLASS II MALOCCLUSIONS—A POSTERO-ANTERIOR CEPHALOMETRIC EVALUATION

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AIM: To evaluate dentoskeletal features of Class II malocclusions in the transverse plane during the mixed dentition phase.
SUBJECTS AND METHOD: Forty-nine subjects with a Class II malocclusion (mean age 7.8 years) were compared with a group of 50 subjects with normal occlusion (mean age 8 years). Dental casts and postero-anterior (PA) radiographs were evaluated for each subject. Transverse measurements on the dental casts included intermolar width and transverse

discrepancy. On the digitized PA cephalograms, 14 width measurements (10 skeletal and four dental) were derived by connecting bilateral cephalometric landmarks. To analyse the error of the method, 25 randomly selected PA radiographs were retraced and redigitized. The mean value of the method error was 0.55 ± 0.23 mm. The two groups were compared by means of independent sample *t*-tests.
RESULTS: Statistically significant differences ($P < 0.05$) were observed for maxillary skeletal, maxillary intermolar, and nasal widths, which were smaller in the Class II group. An average transverse discrepancy of –3.0 mm was recorded on the dental casts of the Class II subjects, due to a significantly narrower upper intermolar width.
CONCLUSIONS: Subjects with a Class II malocclusion in the mixed dentition present with a deficiency in the dentoskeletal transverse dimensions of the maxilla when compared with normal subjects. A therapeutic phase with rapid maxillary expansion is recommended for correction of the dentoskeletal transverse components of a Class II malocclusion.

5 DOES LABIAL MOVEMENT OF LOWER INCISORS INFLUENCE THE LEVEL OF THE GINGIVAL MARGIN?

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AIM: (1) To evaluate the association between the extent of labial movement of the lower incisors and the prevalence and severity of gingival recession (GR) in orthodontically treated adult patients, and (2) to study whether any skeletal, occlusal, and soft tissue parameters are risk factors for labial recession of lower incisors in adults undergoing labial movement as part of orthodontics.
MATERIALS AND METHODS: This retrospective case–control study was based on analysis of study casts and intra-oral slides of 300 adult patients. One hundred and fifty pairs matched by age and sex were selected using simple random sampling. Recordings of gingival recession were made using casts as well as intra-oral slides. Dental displacement was made using cast measurements before and after treatment. One hundred and fifty adult patients (mean age 33.7 ± 9.5 years) treated non-extraction with fixed appliances were studied before and after treatment. Lateral headfilms, study casts, and intra-oral slides were analysed with respect to the amount of pre-treatment overjet, overbite, degree of crowding, presence of tooth rotation, canine relationship, vertical face height, position of the lower incisor to A–Pog line and ML line. Pre-existing GR, width of keratinized gingiva, gingival biotype, gingival inflammation, and visual plaque accumulation were recorded on standard intra-oral slides. Variables included in a logistic regression analysis as possible predictors of GR were identified with a bivariate correlation analysis. Only those with a significant bivariate association were included in the logistic regression analysis. This led to the following variables being evaluated as possible predictors: overjet (≤3 mm/>3 mm), mean width of keratinized gingiva (<3.45 mm/≥3.45 mm), biotype (thin in all four incisors/at least one thick), and inflammation (none/at least one incisor with inflammation).
RESULTS: The intra-oral slide recordings of gingival recession were more reliable than the cast recordings. Comparing the mean recession value between cases and controls, no significant difference could be found ($P > 0.10$). The mean value of the extent of recession in the four lower incisors amounted to 0.36 mm among cases and 0.22 mm among controls. The difference in prevalence of individuals with GR among cases and controls was statistically significant ($P < 0.001$). The mean difference between the members of a pair was 0.14, i.e. of no clinical relevance.
CONCLUSIONS: Faced with the alternative of extractions or labial movement of lower incisors, the present study indicates that the latter is a valuable alternative leading to no clinically relevant deterioration of the periodontium. Age, thin gingival biotype, and plaque-inflammation are useful predictors of GR. None of the orthodontically related variables was significantly associated with GR.

6 CEPHALOMETRIC EVALUATION OF DENTOSKELETAL CHANGES CONCURRENT TO MAXILLARY SPLINT WITH HIGH PULL HEADGEAR

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AIM: To quantify the effects of the maxillary splint and high pull headgear on Class II division 1 patients with a severe gummy smile.
SUBJECTS AND METHOD: Thirty-five subjects (average age 11.5 years) were divided into two groups. Group I comprised the study group of 20 patients and group II 15 patients as the controls. Thirty-seven linear and angular parameters were measured and compared on lateral cephalograms before and 1.5–2 years after treatment. The appliance consisted of a maxillary splint with a facebow fitted in the tube, which was embedded in acrylic in the molar region. All patients received high-pull headgear. The force magnitude was between 400 and 500 g per side.
RESULTS: The SNA value decreased by a mean of 0.50 degrees in group I. An average retraction of 1.90 mm and intrusion of 4.36 mm were observed in group I compared with the controls. The maxillary dentition was both tipped and bodily distally displaced. Downward and forward growth of the maxilla was inhibited or even slightly reversed in the study group compared with the controls. The mandibular incisors exhibited slight uprighting. Significant inhibition of vertical development of the mandibular molar was observed in the splint group. Freeing the posterior occlusion did not enhance mandibular growth. There were no significant differences in mandibular changes between the groups.
CONCLUSION: The most significant changes occurred in overbite, overjet, and correction of the incisor and molar relationship. Using this appliance in Class II growing subject

with severe gummy smile may eliminate the need for orthognathic surgery.

7 MATRIX METALLOPROTEINASE -2, -8, -9, AND -13 IN GINGIVAL CREVICULAR FLUID OF SHORT ROOT ANOMALY PATIENTS

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AIM: To identify and characterize the possible presence of matrix metalloproteinase (MMP) -2, -8, -9, and -13 in gingival crevicular fluid (GCF) of patients with short root anomaly (SRA), and to address in more detail the molecular mechanisms of periodontal remodelling associated with short rooted teeth in this rare anomaly.
SUBJECTS AND METHODS: GCF samples were collected with filter paper strips from affected maxillary central incisors and premolars of five SRA patients and five systemically and periodontally healthy controls. GCF samples were analysed by the zymographic technique for gelatinase A and B (MMP-2 and -9) and by Western blot for collagenase -2 and -3 (MMP-8 and -13).
RESULTS: SRA GCF revealed MMP-9 (30 per cent of the total gelatinolytic activity), of which 18 per cent was in 90 kDa proform and 12 per cent in 71–82 kDa active form. Moreover, high molecular weight complexes (37 per cent) and low molecular size fragmented (33 per cent) gelatinolytic enzymes were detected. No MMP-8 and -13 immunoreactivities were found.
CONCLUSION: Activation and complex formation of MMP-9 is characteristic of SRA GCF, and there is evidently low collagenolytic resorptive or pathological activity in the GCF of SRA teeth.

8 TREATMENT AND POST-TREATMENT EFFECTS OF MAXILLARY PROTRACTION

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AIM: To evaluate short- and long-term effects of maxillary protraction with a Tübinger facemask.
SUBJECTS AND METHOD: Twenty-nine consecutively treated patients (19 boys, 10 girls) with a retruded maxilla and a negative overjet. The age at the start of treatment was 8.8 years (SD 1.2) with a range from 5.8 to 11.2 years. The patients were followed during 6.6 years (SD 0.8). No cleft patients were included. The facemask was attached to a fixed expansion appliance and used 12–14 hours a day including nights, with a protraction force of 500–600 g on each side. Active treatment time was 0.4 years (SD 0.1). When a positive overjet and a straightened soft tissue profile were achieved, the mask was worn successively less (mean 0.6 years). Hard and soft tissue changes were analysed on cephalograms on a computer. Twenty-two hard tissue and 22 soft tissue landmarks were digitized.
RESULTS: After treatment the skeletal relationship and the soft tissue profile were improved in all patients. The maxilla moved forward during treatment (point A to SN perpendicular) 1.8 mm (SD 1.0) and totally at the last registration 4.7 mm (SD 2.3). Soft tissue point A to SN perpendicular moved forward 1.4 mm (SD 1.6) and totally at the last registration 7.0 mm (SD 3.4). At follow-up three of the patients (10 per cent) needed orthognathic surgery.
CONCLUSION: Early treatment with a protraction headgear can successfully influence the position of the maxilla.

9 THE INFLUENCE OF EXTRACTION THERAPY ON THE ERUPTION PATTERN OF THIRD MOLARS

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AIM: To evaluate the effects of extraction treatment on the position of mandibular third molars.
MATERIALS AND METHOD: Lateral cephalograms and pantograms obtained from 50 patients pre- and post-treatment and 20 control individuals before and after the control period. All individuals had an Angle Class I molar relationship in the full dentition with both mandibular third molars present. The patients were successfully treated with fixed appliances by extraction of first premolars and control subjects had no history of previous orthodontic treatment. The mean pre-treatment/control chronological ages were 13.90 ± 0.14 and 14.16 ± 0.09 years, respectively. The treatment/control period was approximately two years. The cephalometric films were analysed according to Björk's mandibular structural superimposition method. All tracings were digitized and the changes were evaluated statistically.
RESULTS: Retraction of the lower incisors and mesial movement of the mandibular first molars was significant in the treatment group, and the difference between the two groups was statistically significant. All of the parameters related to the third molar position changed significantly in the treatment group. Vertical movement and angulation of the third molars was not significantly different between the two groups but there was a significant difference between the groups for mesial movement. Some of the dental and skeletal parameters were highly correlated with the position of the third molars.
CONCLUSIONS: Extraction therapy does not guarantee an improvement in the eruption pattern of third molars. Many other factors influence third molar eruption and there is great individuality.

10 SERUM ALKALINE PHOSPHATASE AND CALCIUM CHANGES DURING ORTHODONTIC TREATMENT

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AIM: Tooth movement during orthodontic treatment is achieved by biological changes that cause teeth to move

through bone. Previous studies have shown that a deficiency of calcium can result in more rapid orthodontic movement. Changes in alkaline phosphatase in serum have been used as a marker to monitor bone changes. The purpose of this study was to investigate calcium and alkaline phosphatase of patients during different periods of fixed orthodontic treatment.
MATERIALS AND METHOD: Blood samples were collected from 100 patients, aged 12–33 years. Data were obtained from group 1 before insertion of fixed appliances and in groups 2, 3, 4, and 5 after insertion at one week, one month, one year, and two years, respectively. All groups consisted of 20 patients. The Mann–Whitney *U*-test from the SPSS statistics program was used to analyse the significant differences within groups across time.
RESULTS: Certain differences were found in the amount of alkaline phosphatase and calcium during different periods of fixed orthodontic treatment. Calcium serum levels decreased at the beginning of treatment and remained almost constant. However, alkaline phosphatase serum levels increased at the beginning of treatment, but decreased to the initial values at the two-year follow-up.
CONCLUSIONS: Fixed orthodontic treatment may stimulate remarkable changes in calcium and alkaline phosphatase serum levels of orthodontic patients.

11 A COMPARISON OF THREE DIFFERENT MYOFUNCTIONAL APPLIANCES IN THE TREATMENT OF CLASS II DIVISION 1 MALOCCLUSIONS

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AIM: To evaluate the skeletal and dento-alveolar changes induced by three different myofunctional appliances during a treatment period of 12 months.
SUBJECTS AND METHODS: Forty-five female subjects (mean age 10.6 years) with Class II division 1 malocclusions were divided equally into three groups according to the appliances used: group A treated with a Twin-Block, group B with a Monobloc, and group C with an Andresen plate. A lateral cephalometric radiograph was obtained before and after a treatment period of 12 months.
RESULTS AND CONCLUSIONS: There was a highly significant increase in SNB angle ($P < 0.001$) in both the Andresen and Twin-Block groups. The mandibular base length was increased in both the Twin-Block ($t = 7.8$) and Andresen ($t = 4.7$) groups. Dental measurements: UI/SN angle showed a significant decrease in the Monobloc group ($t = 7.2$) compared with the Twin-Block ($t = 5.5$) and Andresen ($t = 4.7$) groups. LI/Mp angle showed a highly significant increase in the Monobloc group ($t = 5.36$). The minimum bite opening with the myofunctional appliances had an influence on the skeletal changes. This was evidenced by the Andresen plate, which had the greatest effect on skeletal growth, followed by the Twin-block and finally the Monobloc appliance. Conversely, the Monobloc appliance showed the greatest effect on the dento-alveolar structures followed by the Twin-Block and finally the Andresen plate.

12 THECA CRANII MORPHOLOGY. LONGITUDINAL CEPHALOMETRIC STANDARDS FROM 6 TO 21 YEARS OF AGE

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AIM: To establish and describe normative cephalometric standards of the theca cranii for Norwegian males and females from 6 to 21 years of age using lateral cephalograms.
SUBJECTS AND METHOD: Thirty-five males and 37 females from the Oslo University Growth Archives who had lateral cephalograms taken every third year from 6 to 21 years of age. All subjects were Caucasian, all had a normal occlusion and no apparent facial disharmony, and none had undergone orthodontic therapy. Eighteen measurements and three indices of the theca cranii were analysed longitudinally. Two measurements in the anterior and posterior cranial base were also included. Comparisons between the various parameters in the theca cranii of males and females in each age group were performed using the Student's *t*-test.
RESULTS: The size of the neurocranium of females was smaller than that of males throughout the observation period and the differences increased with age, particularly the diameter of the neurocranium (n–l), length of the neurocranium (n–opc), anterior cranial base length (n–s), and posterior cranial base length (s–ba).
CONCLUSIONS: Cephalometric standards for the theca cranii and cranial base can be used as references in the study of individuals with various craniofacial aberrations and syndromes.

13 STABILITY AFTER MAXILLARY ADVANCEMENT IN JAPANESE CLEFT PATIENTS USING RIGID EXTERNAL DISTRACTION

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AIM: Distraction osteogenesis (DO) is an alternative method for the improvement of maxillary growth retardation. The aim of this study was to assess the positional changes and stability of the maxilla after DO with a rigid external distraction (RED) device following Le Fort I osteotomy.
SUBJECTS AND METHOD: Eight Japanese non-syndromic cleft patients (four males, four females) with severe maxillary growth retardation (five unilateral cleft lip and

palate, two bilateral cleft lip and palate, and one cleft palate). The mean age at osteotomy was 13.2 years (range 9.3–19.8 years). Stability of the maxilla was analysed according to the maxillary antero-posterior changes and rotation of the palatal plane on cephalograms at the following stages: (1) shortly before osteotomy; (2) immediately after removal of the device; and (3) at least six months after osteotomy.
RESULTS: The mean amount of maxillary advancement during distraction was 9.4 mm (range 4.0–14.5 mm) and the mean rotation change was 7.0 degrees (range –12 to +15°). Cephalometric measurements showed a mean maxillary antero-posterior relapse of 21 per cent (range 13.3–24.1 per cent, mean 2.0 mm). On the other hand, rotation of the palatal plane showed a high recovery tendency post-operatively. A positive correlation between the amount of maxillary advancement and post-operative relapse was observed ($r = 0.72$, $P \leq 0.05$).
CONCLUSIONS: Based on cephalometric analysis, maxillary DO exhibited relatively good antero-posterior skeletal stability.

14 HYPERSENSITIVITY TO ORTHODONTIC MATERIALS: COMPARISON AMONG PATIENTS AND OPERATORS

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AIMS: The interest in contact pathologies caused by orthodontic appliances has increased over recent years. The aims of this investigation were to determine the frequency of hypersensitivity to resins and metals used in orthodontic appliances in patients and dental operatives and to verify the relationship between metal allergy and previous orthodontic treatment and piercing.
SUBJECTS AND METHOD: From September 1999 to November 2000, 80 patients (37 males, 43 females, mean age 44 years) with allergic predisposition were selected and divided into four groups: 20 orthodontic patients; 20 dentists; 20 orthodontists; 20 final year dental students. All were patch tested with different commercial resins using the EECDRG standard and dental series (Bracco, Milan, Italy). The patch tests (Finn Chambers on Scanpori®, Alpharma AS, Norgesplaster, Norway) were applied on the subjects' backs, removed after 48 hours and interpreted after 48 and 72 hours. Those subjects who tested positive to metals were questioned regarding previous orthodontic treatment and piercing.
RESULTS: Patch testing identified 18 dentists/orthodontists (22.5 per cent) and three patients (3.75 per cent) who were sensitive to some allergens. From November 2000 to November 2001 these subjects were checked and only seven showed contact pathologies (33.3 per cent). The replies to the questionnaire indicated that whilst orthodontic therapy before piercing did not increase the prevalence to metal sensitization, piercing before appliance insertion sensitized to metals all subjects undergoing orthodontic therapy.
CONCLUSION: The results confirm the prevalence of professional contact allergy and the correlation between piercing and metal sensitization.

15 THE ERUPTIVE PATTERN OF UPPER CANINES: A PRELIMINARY RADIOGRAPHIC STUDY

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AIM: To analyse the eruptive pattern of upper canines on dental pantomograms (DPTs) of a sample of Italian children.
SUBJECTS AND METHOD: Twenty untreated subjects (eight males, 12 females), aged from 7.6 to 8.6 years, in the mixed dentition with a Class I molar and canine relationship. Three DPTs were taken for each subject: in the early mixed dentition (T0), in the inter-transitional phase (T1), and in late mixed dentition (T2). In order to evaluate the inclination of the upper canine and its relationship with anatomical structures, the following angular variables were measured: angle λ, between the upper canine long axis and the horizontal plane passing through the nasal floor; angle γ, between the upper canine long axis and the sagittal plane passing through the anterior nasal spine; angle β, between the upper canine long axis and lateral incisor long axis. Mean and standard deviations were calculated. A Student's *t*-test for paired comparison was used to assess any significant change for each variable.
RESULTS: No statistically significant differences were found between T1 and T0 DPTs for angles λ and γ, whereas they appeared significantly reduced at T2 ($P < 0.001$). Angle β showed a significant increase at T1 ($P < 0.001$) and a significant reduction at T2 ($P < 0.001$).
CONCLUSION: At T1 the upper canine shows mesial inclination and close proximity to the lateral incisor, whereas it appears more upright in the late mixed dentition. Knowledge of the eruptive pattern of the upper canine is important in early diagnosis and treatment.

16 A COMPARATIVE STUDY OF EXTRACTION AND NON-EXTRACTION TREATMENT ON DENTOFACIAL STRUCTURES

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AIM: To evaluate the effects of extraction (E) and non-extraction (NE) treatment in Class I, II, and III cases.
SUBJECTS AND METHOD: One hundred and seven patients (43 males, 64 females) with a mean age of 14.27 ± 2.76 years. The average treatment period was 1.85 ± 0.43 years. The sample was classified into skeletal subgroups according to the measurement of ANB angle (Class I 0–4°, Class II >4°, Class III <0°). Forty-seven subjects

were Class I (E: 22, NE: 25), 40 were Class II (E: 20, NE: 20), and 20 were Class III. Pre- and post-treatment lateral cephalograms and dental casts were collected. Thirteen angular and six linear measurements were assessed from the cephalograms. Eight linear measurements were made on the dental casts. Collected data were analysed using paired *t*-tests for intra-group comparisons and Student's *t*-test for inter-group comparisons.
RESULTS: Comparisons between the E and NE cases demonstrated significant differences in the upper and lower incisor and lip position. NE cases showed significant incisor and lip protrusion. Interpremolar and intermolar widths were also significantly higher in the NE group. No significant differences were found in the vertical dimensions.
CONCLUSION: The decision as to whether or not to extract basically depends on incisor and lip protrusion and not on the vertical pattern, i.e. subjects with concave profiles may respond better to NE treatment while protrusive patients may benefit from extractions.

17 INDUCTION OF BONE-SPECIFIC TRANSCRIPTION FACTOR CBFA1 AFTER MECHANICAL STIMULATION OF HUMAN PERIODONTAL LIGAMENT OSTEOBLAST-LIKE CELLS

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AIM: To investigate the involvement of the bone-specific transcription factor CbFa1 in the biochemical response of human periodontal ligament (PDL) fibroblasts after mechanical loading.
MATERIALS AND METHODS: PDL osteoblastic cells (hPDL) isolated from healthy patients were subjected to static loading for various time intervals. DNA-binding activity was studied by electrophoretic mobility shift assay. In-gel-kinase assays using CbFa1 as substrate and co-immunoprecipitation assays were also employed in order to investigate the *in vitro* and *in vivo* physical interaction between CbFa1 and MAP-kinases.
RESULTS: Increased DNA-binding activity was evident after mechanical stimulation of PDL-cells. The in-gel-kinase and co-immunoprecipitation assays demonstrated that CbFa1 is a direct target of mechanical signals, an effect that is mediated by MAP-kinase-catalysed phosphorylation of this transcription factor.
CONCLUSION: This study provides the first evidence that a bone-specific transcription factor is involved in the biochemical response of osteoblast-like cells to mechanical perturbation. Furthermore, it indicates the putative involvement of mechanical loading in the differentiation processes of bone tissue.
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18 OVERJET CHANGE IN CLASS II DIVISION 1 MALOCCLUSIONS WITH FUNCTIONAL APPLIANCE TREATMENT—AN ETHNIC COMPARISON

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AIM: Dentofacial morphology differs significantly between Chinese and Caucasians with Class II division 1 malocclusions (Lau and Hägg, 1999), e.g. the maxillary incisors are more proclined in Chinese. The aim of this study was to compare the mechanism of overjet changes in young Chinese and Caucasians with Class II division 1 malocclusions treated with functional appliances.
SUBJECTS AND METHODS: Twenty consecutive male patients with skeletal Class II malocclusions from each ethnic group treated with a headgear activator (van Beek, 1982) for 12 months. The construction and adjustment of the appliances followed the same protocol. Cephalograms were obtained at the start and after 12 months of treatment and analysed according to Pancherz (1982).
RESULTS: The overjet change was significantly larger in Chinese than Caucasians, 4.7 versus 3.4 mm, respectively. There was no significant maxillary or mandibular forward growth in either ethnic group, with no significant difference in improvement of the jaw base relationship, being 2.4 versus 2.7 mm, respectively. The maxillary incisors were significantly more retruded ($P < 0.01$) and the mandibular incisors more protruded (ns) in Chinese, i.e. dental changes were significantly ($P < 0.01$) more pronounced in Chinese (2.3 mm) than in Caucasians (0.8 mm).
CONCLUSIONS: The sagittal skeletal changes were similar in both ethnic groups, but the overjet change was larger in the Chinese patients due to larger dental changes. The difference in the overjet changes between the two ethnic groups might be due to differences in incisor angulation prior to treatment, i.e. more proclined incisors were affected to a larger extent by treatment with the headgear activator.

19 THE EFFECT OF CIRCUMFERENTIAL SUPRACRESTAL FIBROTOMY ON ORTHODONTICALLY ROTATED PREMOLARS

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AIM: The stability of rotated teeth is considered to be one of the most difficult goals to achieve in orthodontics. The aim of this investigation was to study the effect of circumferential supracrestal fibreotomy (CSF) on the stability of orthodontically rotated premolars with and without retention and to assess the clinical adaptability of the procedure.
SUBJECTS AND METHODS: Twenty-eight premolars were selected which were rotated with a NiTi closed coil spring on the palatal and a NiTi open coil spring on the buccal side. The surgical procedure was performed according to the method described by Edwards. The investigation was carried out on four groups: Group I, only rotation; Group II, after

rotation CSF was performed; Group III, rotation plus four weeks retention; Group IV, rotation plus CSF and four weeks retention. Impressions for the cast analysis were taken on day 0 and after 1, 2, 4, and 12 weeks. The groups were compared by the one-way ANOVA comparison test of the SPSS program for Windows.
RESULTS: When Group I was compared with Group II there was no significant difference in weeks 1 and 2 but there was a significant difference in weeks 4 and 12. When Group III was compared with Group IV no significant difference was found in weeks 1 and 2 but there was a significant difference in weeks 4 and 12. This shows that the effect of CSF is not immediately apparent but its significance increases with time.
CONCLUSION: CSF is a simple surgical procedure with no apparent damage to the soft tissues and is effective in alleviating rotational relapse.

20 INCIDENCE OF DIFFERENT TYPES OF FACIAL CLEFTS IN CAMBRIDGE AND THEIR OUTCOME

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AIM: To assess the incidence of different types of facial clefts in the Cambridge area (by postcode) and to report the outcome of these cases.
MATERIALS AND METHOD: Antenatal ultrasound (US) records from the obstetric ultrasound department, post-natal records from the regional craniofacial unit, and autopsy reports of foetuses over 16 weeks' gestational age from the regional pathology department over a five year period (1993–1997) were retrospectively reviewed. Cross-referencing between the three data sets identified all cases of facial clefts.
RESULTS: From 23,577 live and stillbirths, 30 had facial clefts. Antenatal US detected 17 of these cases. Sixteen of the 30 had isolated facial clefts. Others had associated anomalies, chromosomal defects, or syndromes. Twenty-one resulted in live births, seven terminations, and two foetal demise. For the purpose of antenatal detection rates, four cases were excluded from analysis. Seventeen of the remaining 26 cases were detected by antenatal US (65 per cent), comprising: 2/3 (67 per cent) isolated cleft lip, 13/14 (93 per cent) cleft lip and palate (CLP), and 2/9 (22 per cent) isolated cleft palate. There were no false positive diagnoses.
CONCLUSION: The incidence of facial cleft was 0.127 per cent for isolated CLP, which is lower than previously reported: 0.67 per 1000, respectively. The outcome is invariably dependent on other associated abnormalities. In this group all except one of those with isolated facial clefts resulted in live births, the residual terminations were in foetuses with multiple anomalies. The data presented report the full incidence of facial clefts in a regional population, including stillbirths and terminations, and may contribute in providing information for effective counselling in joint CLP clinics where antenatal presentations of affected parents are common.

21 EFFECTS OF ORTHOGNATHIC SURGERY ON SIGNS AND SYMPTOMS OF TEMPOROMANDIBULAR DISORDERS: A LONG-TERM EVALUATION

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AIM: To investigate longitudinally whether or not orthognathic surgery initiates or aggravates signs and symptoms of temporomandibular disorders (TMD).
SUBJECTS AND METHODS: Fourteen adults (nine males, five females) with a mean age of 22.9 years (range 26–35 years). All patients were examined by a single examiner according to the research diagnostic criteria. Muscle tenderness was also assessed by means of pressure algometry. Assessments were taken at the following sessions: T0, one week before surgery; and at the following periods after removal of rigid fixation: T1, one week; T2, one month; T3, six months; T4, one year. Data were analysed by repeated measurements analysis of variance (ANOVA).
RESULTS: Before surgery 71.4 per cent of patients were affected with joint clicking whilst after one year only 28.6 per cent were still affected (Fisher's test: $P = 0.056$). Maximum mouth opening was markedly decreased at T1 ($P < 0.001$), increased progressively during the study, but was still significantly reduced at T4 (–12 per cent: $P < 0.01$). At the one-year follow-up, maximal protrusion and lateral mandibular movements were not significantly different from baseline ($P > 0.05$). Pressure pain thresholds did not change significantly throughout the study ($P > 0.05$).
CONCLUSIONS: Orthognathic surgery does not initiate or aggravate signs and symptoms of TMD. Conversely, joint clicking tends to diminish.

22 FINITE ELEMENT SIMULATION OF THE LOADING OF MINI-IMPLANTS FOR ORTHODONTIC ANCHORAGE

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AIM: In recent years, different concepts for implants serving as orthodontic anchorage units have been developed. The biomechanical effects on the alveolar bone as a result of orthodontic loading and/or masticatory forces have not been sufficiently investigated. It was the aim of this study to develop numerical models for the simulation of different anchorage schemes for molar movements in the lower arch.
MATERIAL AND METHODS: Finite Element (FE) models of specially designed orthodontic mini-implants (OMI) in different lengths of 6, 8, 10, and 12 mm were generated. A bicortical anchorage was simulated, with a thickness of the vestibular and lingual cortical bone of 1 mm each. Young's

modulus of cortical and spongious bone were 15 and 1 GPa, respectively. Young's modulus of the implant material, Tikrutan LT31, was set to 100 GPa. The different anchorage concepts simulated were as follows: direct anchorage employing a T-loop in the segmented arch approach, and two types of indirect anchorage employing an elastic powerchain or a coil spring simulating arch-guided tooth movement. The calculations were performed using the FE-package COSMOS/M 2.6.
RESULTS: Forces of up to 5 N and torques up to 25 Nmm resulted in strains in the vestibular cortical bone as high as 650 μstrain. Strains in the spongious bone and lingual cortical bone declined to 25 μstrain. No peaks in the von Mises stress could be determined in the screw pitches.
CONCLUSIONS: Bone loading in the cortical bone due to all simulated orthodontic force systems was sufficiently high to ensure preservation of the bone structure. However, strains in the spongious and lingual cortical bones were below Frost's remodelling limit. In these regions preservation of the bone structure must be ensured by masticatory forces.

23 MATERIALS SCIENCE AND BIOMECHANICAL ANALYSIS OF CURRENT SUPERELASTIC NICKEL TITANIUM WIRES

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AIM: The development of orthodontic nickel titanium (NiTi) wires is influenced by the fact that new products with altered material properties constantly enter the market. As a consequence it is impossible for the clinician to assess the applied force systems. It was the aim of this study to test and implement a standardized measuring procedure, to allow a direct comparison of wires.
MATERIAL AND METHODS: A total of 25 different superelastic NiTi wires from different manufacturers were investigated, each with a set of 20 wires from two packages of different batches. The following measurements were carried out at an ambient temperature of 37°C: a three-point bending test with a support distance of 10 mm recording force/deflection curves, a biomechanical simulation measurement with the Orthodontic Measurement and Simulation System, as well as a pure flexure test recording bending moment/bending angle relationships in a specialized set-up. The mean force, the gradient, and the plateau characteristics were determined from the force/deflection curves. From the moment/angle relationship the mean bending moment, the plateau characteristics, and the material parameters were derived.
RESULTS AND CONCLUSION: The height (0.8–4.5 N), the ending point (0.2–0.9 mm), and the gradient (0.2–2.1 N/mm) of the plateaus differed significantly. Extreme forces of up to 6 N inhibited clinical utilization of the plateau. There were only minor fluctuations between different batches. Clinically relevant force systems can be derived from the three-point bending test, whereas the pure bending test delivers basic data for product improvement.

24 SERIAL EXTRACTIONS IN ORTHODONTICS: STRUCTURAL AND FUNCTIONAL INDICATIONS

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AIM: Serial premolar or molar extractions during treatment result in different structural and functional consequences. The aim of this experiment was to compare the different extraction sites in relation to the anatomical and gnathological consequences of treatment, and to realize an 'extraction map' that can assist in the choice of extractions according to the patient's skeletal typology and dental malocclusion.
SUBJECTS AND METHOD: A group of patients, with an age range between 8 and 27 years (average 13 years), previously treated with permanent molar or premolar serial extractions. Analysis and comparison of some structural and functional parameters (vertical and sagittal cephalometric evaluations in lateral projection, mandibular position indicators, condylar tracings and muscle behaviour) registered before and after orthodontic treatment, for each patient and for each type of extraction.
RESULTS AND CONCLUSIONS: Second premolar serial extraction was the most frequent extraction pattern undertaken in the Clinical Department of Orthodontics and Gnathology of Turin University; the best skeletal vertical dimension control offered by that therapeutic choice combines with a lower risk of cranio-mandibular disorders.

25 UNILATERAL CROSSBITE: ELECTROMYOGRAPHIC EVIDENCE OF LOSS OF MASTICATORY MUSCLE COORDINATION DURING MASTICATION

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AIM: Unilateral crossbite is an asymmetric malocclusion responsible for pathological changes in the masticatory cycle pattern. The aim of this work was to electromyographically evaluate the right and left masseter and anterior temporalis muscles, before and after treatment of unilateral posterior crossbite.
SUBJECTS AND METHODS: Forty-nine patients (17 males, 32 females) aged 8 to 13 years, with a unilateral crossbite. The masticatory cycle patterns and electromyographic (EMG) activity of both the masseter and anterior temporalis muscles were recorded with K6-I Myotronics.
RESULTS: Before therapy, when chewing on the crossbite side, EMG masseter activity was significantly lower in comparison with the masseter activity when chewing on the opposite, healthy side ($P < 0.05$). Anterior temporalis activity on the crossbite side was also higher than on the

other, healthy side. After functional appliance treatment, when chewing on the previous crossbite side, the masseter muscle on the same side showed significantly higher activity with respect to the masseter on the opposite side, as occurs in physiological mastication.
CONCLUSIONS: A crossbite is not only a dental malocclusion but is responsible for functional and neuromuscular pathology. This study demonstrated a loss of coordination of the masticatory muscles on the crossbite side compared with muscle coordination on the opposite healthy side, and that functional appliance treatment improves not only the dental occlusion but also neuromuscular function and masticatory muscle coordination.

26 EFFECTS OF AN ORIGINAL FUNCTIONAL APPLIANCE ON MASTICATORY MUSCLES OF TEMPOROMANDIBULAR DYSFUNCTION SUBJECTS

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AIM: To investigate the effects of an original removable functional appliance (Function Generating Appliance, FGA) on masticatory muscle activity in subjects suffering from muscle-related temporomandibular dysfunction.
SUBJECTS AND METHOD: Electromyographic (EMG) analysis was performed in 14 young adults (five males, nine females, with a mean age of 25.5 years) to evaluate the contractile symmetry of the right and left masseter and anterior temporalis muscles. Records were obtained from surface electromyography of maximum voluntary tooth clenching, with and without a functional appliance between the dental arches, after 12 months of therapy. Asymmetry indices and a torque coefficient to estimate the lateral displacement of the mandible were derived from surface EMG recordings.
RESULTS AND CONCLUSIONS: The FGA corrects the torque coefficient with statistical significance. The data show that the appliance has a muscle-deconditioning action, and is able to release the stomatognathic system from occlusal patterns, particularly its neuromuscular component, thus achieving correct mandibular repositioning.

27 EXTERNAL APICAL ROOT RESORPTION IN CLASS II MALOCCLUSIONS: A RETROSPECTIVE REVIEW OF ONE VERSUS TWO PHASE TREATMENT

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AIM: External apical root resorption (EARR) is an imperfectly understood problem of orthodontic treatment. The aim of this study was to test the hypothesis that two-phase treatment, which should be associated with a reduced severity of malocclusion in the fixed appliance stage, is associated with less root resorption.
MATERIALS AND METHOD: The records of children with a Class II malocclusion (overjet >7 mm) participating in a randomized clinical trial of early orthodontic treatment (Tulloch *et al*., 1998) were reviewed. The patients were treated either in two phases, headgear followed by fixed appliances ($n = 48$), functional followed by fixed ($n = 40$), or by a single-phase fixed appliance only ($n = 50$). The groups were similar for age, gender, and malocclusion severity at enrolment. The records examined included anamnestic data and clinical examination for trauma, panoramic roentgenograms prior to the fixed appliance stage and at the end of treatment, and post-treatment maxillary incisor periapicals. The roentgenograms were scored by two examiners for root development, morphology, and EARR ($n = 552$ incisors).
RESULTS: Eleven per cent of central and 14 per cent of lateral incisors demonstrated moderate to severe (>2 mm) EARR. The highest resorption rate was seen in the single-phase treatment group. Teeth that experienced trauma or exhibited unusual root morphology were more affected. The finding that root morphology, duration of fixed appliances, and one- versus two-phase treatment protocol are related to root resorption is supported by a significant relationship ($P < 0.01$).
CONCLUSION: Two-phase treatment in children with a large overjet (>7 mm) may be associated with less root resorption during the entire treatment period.
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28 EXTRACTION VERSUS NON-EXTRACTION AND LONG-TERM STABILITY OF THE LOWER DENTAL ARCH

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AIM: To compare the effects of extraction (EX) and non-extraction (N-EX) fixed appliance treatment on the long-term stability of the lower dental arch using data derived from the literature.
MATERIALS AND METHODS: A systematic review of refereed literature revealed 15 articles investigating the long-term stability of the dentition and reporting the method of treatment and measurements of crowding before treatment (T1), after treatment (T2), and post-retention (T3). The total of 780 patients from these studies were divided into two samples comprising 268 N-EX and 512 EX patients. The mean annual increase of crowding during the post-retention period was calculated for each sample and tested for statistically significant differences using the Mann–Whitney Rank Sum test.
RESULTS: The mean age of the N-EX patients at T1 was 11.32 years and the mean crowding was 4.36 mm. The mean age at T2 was 13.9 years and crowding decreased to 0.94 mm. After the retention period of 3.45 years crowding increased

to a mean of 3.31 mm, which was measured at T3 when the patient was aged 28.49 years. The corresponding values for the EX patients were 12.42 years and 6.22 mm at T1, 14.42 years and 1.21 mm at T2, and retention lasted on average 2.16 years. When the patients were recalled to evaluate the long-term result, they were on average 29.88 years old and crowding had increased to a mean of 3.52 mm. The mean annual increase of crowding during the post-retention period for N-EX treatment was 0.23 mm. The corresponding value in the EX sample was 0.18 mm. There was no statistically significant difference between the N-EX and EX groups ($P = 0.152$).
CONCLUSIONS: There is no difference in long-term stability of the lower arch regardless of whether EX or N-EX treatment is performed. Decisions regarding extractions should primarily be made within the limits set by crowding and/or incisor protrusion and not by the presumption of improved long-term stability.

29 HUMAN IDENTIFICATION IN MASS DISASTER BY RADIOGRAPHS

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AIM: Due to daily catastrophic events occurring in the world, there is an increasing need for a simple and efficient automated system for identification of cadavers. The aim of this study is to present a new method based on the identification of cephalometric markers on radiographs.
MATERIAL AND METHOD: The identification of an individual was based on the study of shapes (i.e. sella turcica) and dimensions (degree and distances of skeletal markers) of cephalometric markers referring to different age (25–60) periods. The method was tested on 50 individuals using multivariate data analysis.

30 ABSOLUTE ANCHORAGE WITH NEW ORTHODONTIC MINI-IMPLANTS

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AIM: The use of implants for anchorage has become increasingly popular in orthodontics. Recently, miniaturized implants have been preferred. The aim of this presentation is to demonstrate an experimentally and clinically tested mini-implant system.
MATERIAL AND METHODS: The Orthodontic Mini Implant (OMI; Altatec, Germany) has a core diameter of 1.2 mm and is available in lengths of 6, 8, 10, and 12 mm. In a clinical pilot study first the design of the OMI was optimized. Subsequently, biomechanical studies were carried out in the lower jaw of a pig to calculate the maximum implant loading. The deformation of the bone as a function of strength and torque was evaluated by a finite element method study. Additional *in vitro* experiments should give further insight into the attachment of human osteoblasts to the surface of the mini implants. Therefore the experimental surfaces were coated with linear peptides (RGDS). In a clinical study the OMI was used in orthodontic patients and loaded both in the sense of direct and indirect anchorage.
RESULTS: The third prototype series of the OMI resulted in an extremely practical design for daily orthodontics. When placing the OMI a moment of 20 Ncm should not be exceeded. The loading of the buccal cortical bone was approximately 650 μstrain, which is in the range of physiological loading for bone maintenance. Linear peptides (RGDS) were able to significantly increase the adhesion of human osteoblasts. The data from the clinical study showed that immediate loading of the OMI was substantial for implant stability. If there was a lack of loading, implant failure was predictable.
CONCLUSION: The OMI system is a practical tool for the improvement of anchorage in the upper and lower arches. The implants can be placed vertically in the alveolar ridge or horizontally between the roots. The main indications for clinical application are distalizing molars in the lower arch, space closure after early loss of first molars in Class I occlusions, and en masse retraction in Class II treatment.

31 BIOMECHANICS OF THE TEMPOROMANDIBULAR JOINT IN MANDIBULAR ASYMMETRY—FINITE ELEMENT ANALYSIS AND CLINICAL FINDINGS

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AIM: To elucidate the biomechanics of the temporomandibular joints (TMJs) in mandibular asymmetry and to clarify the mechanisms involved in TMJ disorders that are observed clinically.
MATERIALS AND METHODS: Three-dimensional finite element models of the entire mandible, including the TMJs, were created to investigate the forces developed on the TMJs during clenching. The standard model was modified by varying the frontal occlusal plane, frontal mandibular plane, and ramus height to simulate asymmetry of the mandible. The stresses on the TMJs on the shifted and non-shifted side were analysed by mean of static analysis and their values were compared with those found in the standard model. An epidemiological study of the relationship between mandibular asymmetry and TMJ disorders was also undertaken in untreated orthodontic patients to support the present analytical models.
RESULTS: All stresses and stress distribution patterns were influenced by an asymmetric mandible; the more the

asymmetry developed the more alteration of the stresses. For each asymmetry model the different stresses between shifted and non-shifted side were found to be directly proportional to the amount of asymmetry. On the non-displaced side all stresses showed higher values while the displaced side was remarkably affected with the changing of stress distribution pattern.
CONCLUSIONS: It seems that the tendency for TMJ disorders to occur on the shifted side or non-shifted side is related to the amount of asymmetry. Although the causes of TMJ disorders are multi-factorial, it is suggested that disturbances in stress distribution through mandibular asymmetry could be one of the mechanisms related to TMJ disorders; therefore establishing a functional occlusion is a matter of significant concern.

32 EFFECT OF SELF-ETCHING PRIMERS ON BOND STRENGTH—ARE THEY RELIABLE?

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AIM: Currently introduced self-etching primers combine the conditioning and priming agents into a single product. The purpose of this study was to determine the effects of three self-etching primers on the shear bond strength of orthodontic brackets and on the bracket/adhesive failure mode.
MATERIALS AND METHOD: For the laboratory study, premolar brackets were bonded to extracted human teeth according to one of four protocols. In the control group, teeth were etched with 37 per cent phosphoric acid. In the experimental groups, the enamel was conditioned with three different self-etching primers, Clearfil SE Bond (CSE), Etch&Prime 3.0 (EP3), or Transbond Plus (TBP), as suggested by the manufacturers. The brackets were then bonded with Transbond XT in all groups.
RESULTS: *In vitro* findings indicate that conditioning with TBP before bonding brackets to enamel surfaces resulted in a significantly ($P < 0.001$) higher shear bond strength (mean 16.0 ± 4.5 MPa) than that of CSE, EP3, and the control group. CSE produced bond strength values (mean 11.5 ± 3.3) statistically comparable to acid etching (mean 13.1 ± 3.1). The use of EP3 for enamel conditioning resulted in the lowest mean shear bond strength value (mean 9.9 ± 4.0). Comparison of the adhesive remnant index scores indicated that there was more residual adhesive remaining on the teeth treated with TBP and conventional acid etching than in the CSE and EP3 groups. To verify the validity of the laboratory findings, in the clinical part of the study, 218 attachments were bonded to 12 patients with TBP. During the 6-month observation period only four of the 218 attachments failed (1.8 per cent).
CONCLUSION: TBP, designed for orthodontic purposes, is time and cost efficient, and can be used with excellent clinical results.

33 ORTHODONTIC FIXED APPLIANCE TREATMENT AND GINGIVAL HYPERTROPHY: EFFECTIVENESS OF LASER-THERAPY

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AIM: After fixed appliance treatment, gingival inflammation characterized by considerable hypertrophy is frequently observed. The condition can provoke the formation of pseudo-pockets that can degenerate into periodontal lesions with formation of infrabony pockets. The aim of the present study was to analyse the therapeutic effectiveness of a non-invasive protocol of laser-therapy to resolve gingival changes.
SUBJECTS AND METHOD: Ninety patients, aged 12–14 years, affected by gingival hypertrophy in at least six papillary sites after fixed orthodontic therapy lasting at least 12 months. After orthodontic treatment the following clinical parameters were recorded: periodontal probing depth >3 mm, clinical attachment loss (CAL), and bleeding on probing (BOP). All the subjects underwent professional periodic oral hygiene (every 4 months) and received the same instructions in personal oral hygiene. In 30 patients (group A) immediate laser-therapy was carried out and the results were re-evaluated after two months. The remaining 60 patients were not subjected to laser-therapy: thirty patients (group B) were re-evaluated after six months, while the other 30 subjects (group C) were re-evaluated after 12 months following the conclusion of the orthodontic therapy.
RESULTS: In group A, all the periodontal indices implied a return to periodontal health. In group B, an average CAL of 0.6 mm was found and BOP was also recorded during the control after 6 months. In group C, the periodontal indices showed a degeneration of the clinical status, with a tendency to the formation of infrabony defects.
CONCLUSIONS: The therapeutic effectiveness of laser therapy in the treatment of gingival hypertrophy after orthodontic treatment is highly significant, the result is predictable, the operative phase is atraumatic, and the early removal of the gingival alteration avoids the formation of pseudo-pockets.

34 ORTHODONTIC PROBLEMS IN PATIENTS WITH DOWN SYNDROME

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AIM: Patients with Down syndrome (DS) often present with orofacial disorders determined by facial skeletal anomalies (hypoplasia of the midfacial region), hypotonicity of the perioral muscles, lips and masticatory musculature and particularly tongue activity (relative macroglossia). The above explain the high frequency of occlusal anomalies in these patients. The aim of this investigation was to evaluate malocclusions and tooth anomalies in patients with DS to

formulate an orthopaedic-functional and/or surgical protocol for treatment of orthognathodontic problems.
SUBJECTS AND METHODS: Two hundred and thirty patients from the Centre for Children with DS at the University of Milano, divided into three groups: under 6 years of age (32 patients), 6–12 years old (176), and over 12 years of age (22). Registration of malocclusions was performed according to the method of the School of Milan, after clinical examination, cephalometric study (dental pantomograph, latero-lateral, and antero-posterior tele-radiographs and radiograph of the left wrist) and analysis of the dental casts.
RESULTS: The frequency of skeletal anomalies was high: 35 per cent presented with an open bite, 60 per cent had a posterior crossbite, 60 per cent hypodontia, and 15 per cent maxillary canine/first premolar transposition. The teeth most often missing were the upper lateral incisors followed by the lower second premolars and upper second premolars. A strong correlation was found between tongue position and malocclusion and between anomalies of the perioral muscles and malocclusion.
CONCLUSIONS: Early orthopaedic-functional and/or surgical treatment of these children could improve their situation, resulting in less stigmatization and greater social integration.

35 A PROSPECTIVE STUDY OF THE MANAGEMENT OF 'SLEEPY SNORERS' WITH MANDIBULAR ADVANCEMENT SPLINTS

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AIM: A prospective clinical trial was undertaken to investigate the treatment of 'sleepy snorers' with a mandibular advancement splint.
SUBJECTS AND METHOD: Nineteen patients diagnosed as 'sleepy snorers' by polysomnography (median age 48.5 years) were treated with a Herbst mandibular advancement splint (MAS). Four baseline questionnaires assessed sleepiness and snoring: visual analogue scales (VAS) of snoring and sleepiness; the SF-36 quality of life questionnaire, and the Epworth Sleepiness Scale (ESS). The patients and their sleeping partners completed a 'sleep history' questionnaire. Questionnaires were repeated after 6 weeks of appliance wear. One upright and two supine radiographs, one with the teeth in occlusion and one with the mandible protruded, were taken. Changes in the pharyngeal dimensions attributed to altering posture or protruding the mandible were noted.
RESULTS: The MAS significantly reduced the symptoms of daytime sleepiness and snoring incidence measured by the VAS and the patient/partner questionnaires ($P < 0.001$). There was a good deal of correlation between the patient and the partner reported symptoms (Kappa values between 0.61–0.80). The energy/vitality dimension of the SF-36 was also significantly highly improved ($P < 0.001$). Eighteen of the 19 subjects had a reduced ESS score (median pre-treatment score of 12 to post-treatment value of 5). Of the 15 subjects who had a pre-treatment ESS >10, 80 per cent had ESS scores within the clinically 'normal' range after wearing the appliance. On examination of the pharyngeal airway, the minimum post-palatal airway dimension reduced significantly on changing posture ($P < 0.05$). On protrusion of the mandible, the tongue proportion reduced significantly, creating a greater functioning space available for the tongue ($P < 0.001$).
CONCLUSION: The Herbst MAS would seem to be an effective treatment modality in 'sleepy snorers'.

36 LONG-TERM MASSETER MUSCLE ACTIVITY IN SUBJECTS WITH DIFFERENT VERTICAL CRANIOFACIAL MORPHOLOGIES

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AIM: To compare the electromyographic (EMG) activity of the masseter muscle of short- and long-faced subjects in their natural environment.
MATERIAL AND METHODS: Digital photographs of the facial profile were obtained from a sample of 200 dental students. From each picture, lower face height (LFH) and total face height (TFH) were assessed. Ten short faced subjects (nine males, one female; mean age ± SD: 23.2 ± 2.5 years) and 10 long faced subjects (nine males, one female; mean age ± SD: 24 ± 4.1 years) were selected from the opposing tails of the distribution fitting of the ratio LFH/TFH. The masseter activity was monitored for 8 hours a day in the natural environment by means of portable one-channel EMG recorders, over three consecutive days. The number and duration of activity periods (AP), their mean amplitude, and the integral of AP versus time were calculated.
RESULTS: None of the EMG variables differed significantly between long- and short-faced subjects (repeated measurement ANOVA: $P > 0.05$).
CONCLUSION: Long-term EMG activity of the masseter muscle in the natural environment was not influenced by vertical craniofacial morphology.

37 FINITE ELEMENT ANALYSIS OF THE INFLUENCE OF MOLAR POSITION ON MAXILLARY LOAD TRANSFER

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AIM: To evaluate the influence of molar position in the mesial/distal aspect on maxillary load transfer in a finite element (FE) model.
MATERIALS AND METHODS: A fully dentate skull was scanned with a slice thickness of 2 mm. The computed tomographic (CT) images were imported into three-dimensional visualization software and the bone structure of

the cranium was segmented and subsequently the left part of the maxilla was virtually dissected from the rest of the skull. The upper left molars were isolated from the surrounding alveolar bone and modelled separately. Finally, the molars were virtually moved half a cusp width mesially and distally, respectively. The resulting three models were imported into an FE-program and meshed. Each bone element was attributed a Young's modulus corresponding to the local grey-value distribution in the original CT scans. The models were loaded with 150 N on each molar and 300 N on the zygomatic arch to simulate bite force.
RESULTS: The maxillary load transfer takes place mainly in the vertical direction starting from the alveoli of the molars. Areas of stress concentration were found in the infrazygomatic crest, on the zygomatic arch where the masseter muscle is attached, and the zone around the roots of the first molar. A mesial shift of the molars resulted in an increase of the load transfer through the frontal process, and a stress concentration on the buccal cortex. A distal shift on the other hand resulted in an increase of the posterior load transfer, whereby the balance between compressive and tensile stresses in itself was not so much altered, but there was a tendency within the tensile stresses towards higher values compared with the neutral model.
CONCLUSION: A minor shift in molar position mesial-distally has a significant effect on the maxillary load transfer.

38 THE INFLUENCE OF MATERIAL PROPERTIES ON FINITE ELEMENT ANALYSIS OF ORTHODONTIC LOAD TRANSFER

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AIM: To assess the influence of the material properties of the alveolar supporting structures on the stress–strain distributions determined by finite element (FE) analyses simulating an orthodontic loading regime.
MATERIAL AND METHODS: A segment of a lower human mandible containing the canine and the first premolar obtained from autopsy was microcomputer tomographically scanned with a voxel dimension of 37 μm. The scans were imported in three-dimensional visualization software to discriminate the different structures, which were subsequently modelled as different geometric entities, imported into an FE-program, and meshed. Based on the same geometry and mesh, three models were generated in which the material properties of the periodontal ligament (PDL) and the alveolar bone were varied. In the first the bone and the PDL were considered to be homogeneous and linear elastic. In the second the material behaviour of the PDL was considered to be non-linear. In the third model the density distribution of the alveolar bone was taken into account by attributing Young's moduli corresponding to the local grey value distribution in the original computer tomographic scans. Different orthodontic loading modes were simulated, including space opening and intrusion/extrusion.
RESULTS: The stress/strain distributions changed considerably in the three models, and especially the load transfer from the root to the alveolar bone depended substantially on the choice of linear or non-linear material behaviour of the PDL. In particular for tipping movements of the teeth, the tooth movements were found to be up to six times larger for the non-linear models.
CONCLUSION: Modelling of the material properties plays an important role in evaluation of the correct load transfer through the alveolar supporting structures. Furthermore it shows that when non-linear material behaviour of the PDL is assumed, the classical perception of having a compressive and tensile area on the opposite sides of the alveolus for tipping movements of the tooth does not hold true.

39 INTEGRIN-MEDIATED ADHESION TO BIOMATERIALS AND ITS ROLE IN TRANSDUCTION OF MECHANICAL FORCES IN BONE CELLS

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AIM: Whilst integrin receptors are best known for their role in cell adhesion and signalling, a growing body of evidence indicates that these receptors have multiple roles in stress response. The purpose of the present work was to investigate the integrin transduction pathways in bone cells subjected to mechanical forces.
MATERIALS AND METHOD: Previously a method for covalently attaching bioactive peptides to silicone membranes and subsequently applying dynamic equibiaxial strain has been described. Osteoblast-like cells (MC3T3-E1) were plated on silicone membranes grafted with RGD peptides and grown to confluence. The covalent link of the RGD peptide to the surface profoundly enhanced the phenotype, mineral formation, and differentiation of osteoblasts. Western blot analysis of whole cell lysates revealed that $\alpha_V\beta_3$ integrin receptors were highly expressed in osteoblasts on RGD-membranes. Furthermore, confocal microscopy showed an increased number of focal adhesion plaques. Inhibition of adhesion with RGD peptides in cell suspension was performed to demonstrate the specificity of integrin–RGD binding. To determine the effects of mechanical loading on integrin expression, osteoblasts were cultured for 3 days on RGD-silicone membranes and subjected to 2 per cent dynamic equibiaxial strain at 15 cycles/minute for 2 hours. Cell lysates were collected at different time points up to 24 hours.
RESULTS: Using Western blot analysis it was found that integrin expression increased compared with non-loaded controls; cells reorganized their cytoskeleton and adhesion plaques were redistributed on the cell surface. Following mechanical stretching, osteoblasts also showed resistance to apoptosis and increased expression of AP-1 transcription factors.

CONCLUSIONS: These data suggest that integrin receptors are involved in the signal transduction of mechanical forces in bone. This provides useful information in understanding the mechanisms following the application of orthodontic forces. Moreover, the RGD peptide can be used to regulate local responses, such as bone mineralization of osteoid tissue formed during orthodontic tooth movement.

40 A HYPOTHETICAL APPROACH TO MORPHOLOGICAL MANDIBULAR CHANGES INDUCED BY OSTEOARTHRITIS OF THE TEMPOROMANDIBULAR JOINT

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AIM: To demonstrate the characteristic features of the craniofacial structure and patterns of malocclusion caused by osteoarthritis in the temporomandibular joint (TMJ) and investigate the mechanism that brought about these changes in an experiment using rabbits based on a hypothesis that the pattern of mandibular movement has a close relationship with the morphological change of the mandible.
MATERIALS AND METHOD: Twelve New Zealand house rabbits weighing an average of 3 kg. Menisectomies were performed on the left TMJs of the rabbits and the right sides were used as the controls. The rabbits were sacrificed 1 and 2 weeks, and 1, 3, and 5 months after menisectomies. The mandible was separated from the cranium and hemisected. The samples were analysed radiographically and evaluated statistically.
RESULTS: Posterior ramus bowing and an increased depth of the antegonial notch were observed on the menisectomy side compared with the control side. Adaptation occurred in the amount of posterior ramal bowing with time.
CONCLUSION: Unilateral menisectomies in rabbits produce an increase in the depth of the antegonial notch and posterior ramus bowing on the affected side. The results are considered to be related to altered stress distribution and masticatory patterns after the menisectomies. Therefore, a functional analysis of the mandible should first be carried out and orthodontic treatment accompanied by functional treatment to restore mandibular movement is considered to be highly desirable in treating subjects with malocclusion with TMJ osteoarthritis.

41 VOLUMETRIC ANALYSIS OF ROOT RESORPTION LACUNAE AFTER APPLICATION OF CONTROLLED ORTHODONTIC FORCES

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AIMS: Root resorption is an unavoidable idiopathic phenomenon in orthodontic treatment. Various types of force applied on teeth and their effects on root cementum have been studied previously. The aims of this investigation were to produce a protocol for a volumetric analysis of root resorption lacunae on controlled samples of human premolar teeth, and to study the effects of force magnitude on resorption and resorption volume.
MATERIAL AND METHOD: A controlled sample of 36 teeth from 17 patients (eight males, nine females, mean age 14.5 ± 1.4 years (11.7–16.4 years) requiring bilateral first premolar extractions for orthodontic treatment (duration 4 weeks) were collected, disinfected, and stored in Milli-Q until experimentation. Patients were randomly divided into two groups. A light (25 g) and heavy (225 g) force was applied to the right premolar using TMA (Ormco) springs in groups 1 and 2, respectively. The contralateral premolars were used as controls. Speed brackets (Strite Industries) were used on the first premolars and molars. The premolars were discluded with glass ionomer cement (3M) occlusal stops on the lower first permanent molars. After extraction, a pair of stereo-images of any existing lacuna was imaged at eucentric point at ±3-degree tilt under SEM (Philips XL30). A three-dimensional image of each crater was digitally composed and analysed using analySIS Pro 3.1 (Oxford Instruments).
RESULTS: Buccally directed tipping forces applied to the teeth consistently caused resorption lacunae on the buccal cervical and lingual apical regions of the cementum. There was a significant increase in the number and volume of the lacunae on premolars in the heavy force group compared with both the light ($P < 0.05$) and control groups ($P < 0.01$).
CONCLUSIONS: Force application is an important factor in root resorption and the amount of root resorption seems to be correlated to the amount of force applied.

42 TEMPOROMANDIBULAR RESPONSE TO EARLY AND LATE REMOVAL OF BITE-JUMPING DEVICES

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AIM: To monitor the amount of bone formed after 'early' and 'late' removal of bite-jumping devices and to compare it with normal growth.
MATERIAL AND METHODS: One hundred and thirty-five female Sprague–Dawley rats, 35 days old, were randomly divided into seven control groups ($n = 5$) and 10 experimental groups ($n = 10$) fitted with bite-jumping devices. On day 30 the bite-jumping device was removed in two groups (early removal) and the rats were sacrificed at days 44 and 60, respectively. On day 44 the device was removed in one group (late removal) who were then sacrificed on day 60. The full-time wear and matched control animals were sacrificed on days 3, 7, 14, 21, 30, 44, and 60, respectively. Tissue sections were cut through the temporomandibular joint in the sagittal plane and stained with Periodic acid and Schiff's reagent (PAS) for the evaluation of new bone formation.
RESULTS: In the condyle, early removal of the appliance resulted in less bone formation compared with that of natural growth. Late removal of the appliance resulted in bone

formation similar to that of natural growth. In the glenoid fossa, the level of bone formation was similar to that of the controls at both early and late removal of the appliance.
CONCLUSION: Early appliance removal results in sub-normal growth of the posterior condyle but not of the glenoid fossa. Increasing the length of mandibular advancement secures normal levels of mandibular growth in the post-treatment period.
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43 BONE FORMATION IN THE TEMPOROMANDIBULAR JOINTS IN RESPONSE TO ONE-STEP AND STEPWISE ADVANCEMENT

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AIM: To quantitatively assess the amount of bone formation in the temporomandibular joint in response to stepwise advancement and to compare it with that of one-step.
MATERIAL AND METHODS: Two hundred and fifty female Sprague–Dawley rats, 35 days old, were randomly divided into 10 control groups ($n = 5$) and 20 experimental groups ($n = 10$). Fifty rats from the stepwise experimental group received 2 mm advancement initially and veneers were added on day 30 with another 1.5 mm advancement. The rats were sacrificed after 3, 7, 14, 21, 30, 33, 37, 44, 51, and 60 days. Tissue sections of 7 μm were cut through the condyle in the sagittal plane and stained with Periodic acid and Schiff's reagent (PAS) for the evaluation of new bone formation. Haematoxylin stain was applied to observe cellular response.
RESULTS: During the first advancement, bone formation in the condyle and glenoid fossa was lower than that in the one-step advancement group. In response to the second advancement, new bone formation in the condyle and glenoid fossa was significantly higher when compared with single advancement, with a maximum increase of 50 and 240 per cent, respectively.
CONCLUSION: Stepwise advancement leads to a significant increase in bone formation when compared with that of natural growth in the condyle and glenoid fossa. In stepwise advancement, the level of bone formation is maintained at higher levels in the later stages of treatment compared with one-step advancement.
Supported by CRCG grant 10203770.22311.08003.323.01 from the HKU.

44 PRIMARY ERUPTION DISTURBANCES OF PERMANENT TEETH

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AIM: Reinclusion of permanent molars is a rare disorder of tooth eruption. Inheritance is considered to be autosomal dominant with complete penetrance.
SUBJECTS AND METHODS: Two generations of two different families were clinically assessed. In both affected subjects there was no evidence of trauma or inflammation, either locally or generally. Case I: an 11.9-year-old Caucasian girl. Oral and radiological examination demonstrated partial eruption of the teeth of the upper and lower molars and premolars on the right side. The alveolar processes in the upper and lower jaws were not fully developed, resulting in a lateral open bite. A computed tomographic (CT) scan confirmed the hypoplasia of the alveolar processes. The left side was normally developed. No other member of the family had any sign of dental reinclusion. Case II: a 12.9-year-old Caucasian girl. Oral and radiolographic examination showed a partly reincluded permanent right second premolar and the permanent molars and the left second molar of the maxilla. In the mandible the right premolars and the molars and molars on the left side were affected. CT scan revealed dysplasia of the right maxillary sinus. The eruption disturbances resulted in a bilateral open bite. Her mother also showed partial eruption of the upper right molars; no other family member showed any sign of eruption failures.
CONCLUSION: Whilst these cases reveal an inheritance of the disorder, no autosomal dominant inheritance could be confirmed in either family.

45 ACCURACY OF SOFT TISSUE PROFILE PREDICTIONS IN ORTHOGNATHIC SURGERY

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AIM: To evaluate the accuracy of soft tissue profile predictions generated by a recently developed computer program (CASSOS 2001) in Chinese Skeletal III patients treated with bimaxillary surgery.
MATERIAL AND METHODS: Pre-surgical and post-treatment lateral cephalograms of 35 Chinese patients who had a combined one-piece Le Fort I and bilateral sagittal split osteotomy to correct their Skeletal III malocclusions. The cephalograms were digitized using the CASSOS 2001 program and a cranial base (7° to S–N line) superimposition was performed. The hard tissue movements were simulated on the pre-surgical cephalogram until good superimposition of the hard tissues on the pre-surgical and post-treatment cephalograms was achieved. A customized cephalometric analysis consisting of 32 linear measurements was used to analyse the differences in the soft tissue profile between the actual post-treatment results and the computer-generated predictions.
RESULTS: Comparison of the predicted and actual changes indicated that 16 of the 32 soft tissue measurements were significantly different ($P < 0.05$). Most of the significant prediction errors were observed in the upper and lower lip region. The software tended to underestimate the vertical position of both the upper and lower lip and overestimate the

horizontal position of the lower lip. The mean prediction errors ranged from 0.01 to 2.02 mm in the vertical dimension and 0.02 to 1.74 mm in the horizontal dimension.
CONCLUSIONS: Bimaxillary surgical correction of pronounced Skeletal III dysgnathia is accompanied by extensive soft tissue changes that are difficult to predict accurately. Additional studies of the soft tissue response to orthognathic surgery on Chinese subjects are needed to provide more algorithmic data for prediction software.

46 A RETROSPECTIVE STUDY OF THE CLINICAL PERFORMANCE OF AESTHETIC BRACKETS

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AIM: To evaluate the performance of the Clarity™ bracket in routine orthodontic treatment. So far no large sample clinical studies on bond/bracket failure are available on aesthetic brackets.
SUBJECTS AND METHODS: One hundred and fifty-two consecutively treated patients (75 adults and 77 children under 16 years of age). The treatment time ranged from 9 months to 2 years 3 months (mean 1 year 6 months). One thousand three hundred and two maxillary brackets and 953 mandibular brackets were used.
RESULTS: Bond failure: the bond failure rate was 0.80 per cent (11) for maxillary brackets and 0.73 per cent (seven) for mandibular brackets. Bracket failure: bracket fractures occurred in 17 maxillary brackets and in 18 mandibular brackets. One tiewing fracture was caused by the operator during adjustment. A surprising finding was that of the 17 tie wing fractures 10 were gingival tie wings. Overall failure (bond/bracket failure): the 17 maxillary bracket failures occurred in nine patients (seven children, two adults). The 18 mandibular bracket failures occurred in seven patients (five children, two adults). All cases with more than one failed bracket were children.
CONCLUSION: The bond failure rates for maxillary and mandibular brackets compare favourably with published studies on metal brackets.

47 CURRENT TRENDS IN TURKISH ORTHODONTICS

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AIM: The aims of this study were (1) to outline a portrait of current orthodontic practice in Turkey, (2) to interpret yielded factors that affect the preferences of Turkish orthodontists, (3) to contribute improvement and progress of orthodontics by detecting any possible deficiencies in Turkish orthodontics, and (4) to constitute a reference for future national and/or Europe-wide and/or international surveys to make possible the evaluation of changes in Turkish orthodontics.
MATERIAL AND METHOD: The study composed a comprehensive questionnaire survey performed to find out the current diagnostic and therapeutic trends in Turkish orthodontics. The questionnaire was sent to 225 members of the Turkish Orthodontic Society. The number of returned questionnaires was 122, a return rate of 54.2 per cent.
RESULTS: According to the results of this survey a Turkish orthodontist: (1) takes orthopantomographs and lateral cephalograms, prepares study casts prior to and after treatment; (2) prefers colour slides for patient records and collects these records more routinely prior to treatment; (3) traces lateral cephalograms manually, utilizes Steiner analysis, uses Hayes Nance and Bolton cast analysis; (4) treats the growing Class II division 1 patient functionally with Activator; (5) bonds Roth prescription 0.018-inch metal brackets directly with no-mix chemically cured orthodontic adhesive and prefers Ni-Ti archwires; (6) is liable for non-extraction treatment; (7) sees the patient once every 3–4 weeks; (8) finishes the case with zigzag elastics and stripping and uses Hawley retainer for retention. Sometimes prepares a bonded lingual retainer for lower anterior. Prefers 1–2 years retention period; and (9) rarely treats surgical orthodontic and CLP patients in private practice and refers these cases to medical centres.
CONCLUSION: The study was concluded with comparison and discussion of data with the results of similar studies performed in other countries.

48 AN EXPERIMENTAL PROTOCOL FOR THE NEUROMUSCULAR ASSESSMENT OF POST-ORTHODONTIC STABILITY

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AIM: To prevent relapse after orthodontic treatment, retention is often considered indispensable. Soft tissues are thought to have a significant influence on dental movements. To quantify the influence of masticatory muscles on post-treatment relapse, in an attempt to avoid unnecessary procedures, morphology and function of two orthodontic patients were followed.
SUBJECTS AND METHODS: Two male patients (13 and 30 years of age at debond) who completed a 2-year fixed orthodontic treatment. Both patients received no post-orthodontic retention. After 1 week and 6 months, alginate impressions of the dental arches and surface electromyography (EMG) of the masseter and temporalis muscles during MVC were performed. The youngest patient underwent EMG recording monthly for the first 6 months, and at the 1-year follow-up. Arch dimensions and three-dimensional (3D) inclination of the facial axis of the clinical crown (FACC) were measured using a computerized digitizer. Symmetry in muscular contraction was evaluated using the percentage overlapping coefficient (POC) and potential lateral displacing components by the torque coefficient (TC).

RESULTS: At the 6-month follow-up, no clinical modifications were observed. Quantitative evaluation showed that the arch dimensions were slightly modified (up to 1 mm). While the adolescent had no modifications in FACC inclinations, the adult had significant alterations (up to 18°). At all examinations of the adolescent, POC were higher than 86 per cent, and TC lower than 10 per cent. In the adult, POC were within normal ranges, while TC were all higher than 10.5 per cent. The larger TC measured in the adult may explain the larger modifications in the 3D position of the dental crowns.
CONCLUSIONS: Surface EMG assessment may help in the detection of patients who might require post-orthodontic retention.

49 A LONGITUDINAL ANALYSIS OF THREE-DIMENSIONAL PALATAL FORM IN HEALTHY ADULTS

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AIM: To provide the best orthodontic treatment and to assess any possible relapse after therapy, an understanding of the normal modifications of the craniofacial complex with ageing is mandatory.
SUBJECTS AND METHODS: A 10-year longitudinal evaluation of the morphology (size and shape) of the hard-tissue palate was performed in six female and six male healthy adults (mean age at the second evaluation 33 years). All subjects had a complete permanent dentition, without respiratory problems. The assessments were non-invasive, and performed without procedures currently known to involve any present or future biological damage. Palatal landmarks were digitized with a computerized three-dimensional instrument, and their coordinates were used to derive a mathematical model of palatal form. Palatal shape (size-independent) was assessed by fourth-order polynomials in the sagittal (one curve from the incisive papilla to a line connecting the first permanent molars) and frontal plane (four curves corresponding to the first permanent molars, second and first premolars, and canines) projections. For each palate, the following measurements were obtained: in the sagittal plane: palatal length, slope, and maximum height; in the frontal plane: palatal width and maximum height at the first permanent molars, second and first premolars, and canines. Dimensions were compared between the two evaluations by paired Student's *t*-tests.
RESULTS: A great variability was observed, but no significant modifications in size were found ($P > 0.05$ for all variables). No variations in shape were observed. Sex had no significant effect on any of the variables (Student's *t*-test for independent samples, $P > 0.05$).
CONCLUSIONS: In healthy subjects, hard-tissue palatal morphology does not seem to change between the third and the fourth decade of life.

50 A MEASURE OF PERFORMANCE?—THE EFFICIENCY FACTOR IN ORTHODONTICS

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AIM: A good treatment outcome depends not only on the result achieved [measured using the Peer Assessment Rating (PAR) Index] but also on the duration of active treatment among other factors. These two variables can be linked to demonstrate the efficiency of an orthodontist, i.e. Efficiency factor = change in PAR points divided by time in months. It was necessary to identify a gold standard, i.e. to quantify good change during a two-year period.
MATERIAL AND METHODS: Pre- and post-treatment study models of most patients treated in three hospital departments of North Yorkshire since 1993 were assessed using the PAR Index. The duration of treatment for each patient was recorded. All PAR scores were averaged for each orthodontist and department for each year under study, together with the duration of active treatment. The average efficiency index was then calculated.
RESULTS: Data were collected for a total of 1867 patients treated by all grades of staff. It has been stated that a change in PAR of 70 per cent represents a good standard of treatment. The average starting PAR varied from 30 to 33 and the average post-treatment PAR from 7 to 9. This represents an average change of 23.5 points, which is slightly in excess of 70 per cent and therefore a good standard of treatment. This change was achieved with an average duration of 23–25 months; therefore the average efficiency factor was almost 1.
CONCLUSIONS: An efficiency factor of 1 is equivalent to a reduction of 24 PAR points over a two-year period and has been adopted as the gold standard. During the study period this improved and for 2000/01 was 1.2. It is suggested that the efficiency factor is a good measure of orthodontic performance.

51 INCREASED HORIZONTAL CONDYLAR ANGLE IN ABNORMAL TEMPORO-MANDIBULAR JOINTS OF PATIENTS WITH JUVENILE RHEUMATOID ARTHRITIS

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AIM: To evaluate whether temporomandibular joint (TMJ) alterations show an increased horizontal condylar angle in patients affected by Juvenile Rheumatoid Arthritis (JRA).
SUBJECTS AND METHODS: The TMJs of 44 patients (38 females, six males) with JRA, with an age ranging from 10 to 25 years, were evaluated through ipocycloidal tomography at individual values. Preliminary axial radiography was performed in order to assess the horizontal condylar angle according to Omnel's technique. The tomographic features were evaluated according to the Rohlin–Petersson scale (grades 0–5 according to the severity of erosive changes) and the horizontal condylar angle was assessed by axial radiography.

RESULTS: Tomographic studies showed TMJ involvement in 76 per cent of JRA patients and the data obtained from the axial radiographs indicated that most of these affected patients (64 per cent) had a larger condylar angle when compared with the mean value of 20 degrees, reported in literature for normal joints. In particular the condylar angle was increased in 58 per cent of the patients without any TMJ degenerations. No linear correlation was found between the increased horizontal angle and the severity of the morphological alterations of the TMJs.
CONCLUSIONS: The horizontal condylar angle is increased in patients with JRA and most have an increased condylar angle either in advanced internal derangement or in normal joints. It would therefore appear that the increase in these angles in JRA patients is independent of the severity of morphological TMJ alterations. The assessment of condylar angle does not in itself have a diagnostic value and is primarily intended for patient positioning and optimal orientation of the X-ray beam.

52 TONGUE THRUST—AN EPIDEMIOLOGICAL ANALYSIS

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AIM: To quantify the number of anomalies in swallowing in an untreated group of children. In the normal population the frequency of tongue thrust has been reported to be between 10 and 82 per cent in children and up to 15 per cent in adults. In the area examined, a survey reported anomalies in swallowing in 20 per cent of children between 3 and 12 years of age.
SUBJECTS AND METHOD: Three thousand five hundred and seventy subjects with an age range between 2 and 50 years were examined. Occlusal traits were evaluated according to the Index of Orthodontic Treatment Need (IOTN). Tongue thrust was assessed clinically, observing perioral muscle involvement and tongue thrust during swallowing.
RESULTS: Tongue thrust was observed in 28.7 per cent of the subjects and the habit appeared to be more frequent between the ages of 7 and 9 years. Borderline treatment need (IOTN grade 3) was present in 26.6 per cent of the subjects, grade 4 in 46.8 per cent, and grade 5 in 18 per cent. An overjet between 3.5 and 6 mm was observed in 33.5 per cent of the cases, and it was >6 mm in 29.8 per cent. A Class II occlusion was present in 50.5 per cent. In 59.6 per cent an increased vertical dimension was observed, with an overbite <1 mm in 34 per cent of the subjects (anterior open bite = 14.5 per cent). A posterior crossbite was present in 23.2 per cent. Habits are important anamnestic data, as finger-sucking (16.9 per cent) and mouth breathing (12 per cent) represent important aetiological factors in abnormal swallowing patterns associated with tongue thrust.
CONCLUSIONS: Subjects with atypical swallowing had frequently been thumb suckers or presented a mouth breathing pattern with increased overjet, reduced overbite, posterior crossbite, frequently associated with labial incompetence, upper labial segment diastemas, and lingual fraenum. Early assessment of the possible presence of detrimental habits, together with evaluation by both an ear, nose and throat surgeon and speech pathologist, could be useful in the prevention of malocclusions associated with environmental factors.

53 TITANIUM MINISCREWS UNDER CONTINUOUS LOADING IN A PIG JAW: A HISTOLOGICAL STUDY

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AIM: There is increasing interest in using titanium miniscrews for orthodontic anchorage. The aim of this experimental pilot study was to evaluate the histological aspect of mandibular bone around miniscrews subjected to continuous forces in a pig model.
MATERIAL AND METHODS: Two transmucosal miniscrews (∅ 2.3 mm length, 2 mm) were inserted on both sides of a pig jaw. Calcein green was injected as a first fluorochrome after surgery. Four weeks after implantation, a nickel-titanium coil spring (50 grams) was fixed between the two left miniscrews, while the right miniscrews remained unloaded for the same follow-up period. The second fluorochrome, terramycine, was injected just before loading. Nine weeks after implantation, the pig was sacrificed and each hemimandible was dissected to isolate the miniscrews. Histological analysis of the screw–bone interface was performed.
RESULTS: Histology revealed bone apposition in contact with approximately one-third of the unloaded screw surface. Fibrous tissue was observed along the other two-thirds of the screw surface. At the interface of this fibrous tissue and the bone margin surrounding it, many osteoclasts and osteoblasts were found, revealing important bone remodelling. No direct screw–bone contact was found around the weight-loaded screws. Concentric fibrous tissue surrounded the screws. Signs of apposition and resorption were found at the interface of this fibrous tissue and the surrounding bone. The bone tissue was well vascularized. No inflammatory reaction was found.
CONCLUSION: Bone apposition appears more abundant around unloaded than loaded screws. The degree of osseointegration will be quantified after a longer follow-up period in future studies.

54 IMPLANTS AS ORTHODONTIC ANCHORAGE IN THE PALATE—A PILOT STUDY

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AIM: To present the first experiences of a clinical trial with an implant system for achieving maximal orthodontic anchorage in the palate.

SUBJECTS AND METHOD: Seventeen patients (10 females, seven males aged 9.0 to 38.11 years, average age 21.5 years). Before surgery, the patients underwent a dental computed tomographic scan (Tomoscan SR 6000, Philips) of the anterior palate. In total 32 InPlants™ (Nobel Biocare, Sweden) were inserted in the paramedian region of the palate (in 15 patients two implants per patient, in two patients one implant). The InPlants™ are transmucosal fixtures made of pure titanium with a diameter of the endosseous part of 2.5 mm and a length of 3 mm. Stainless steel caps were connected to the teeth of the reactive unit and were cemented on the top of the implants. After a mean healing period of 3 days after insertion, the fixtures were loaded indirectly with a mean force of 200 cN (maximum 300 cN, minimum 70 cN).
RESULTS: As a result of inadequate primary stability two implants were lost during installation; due to local bone quality the insertion torque was too high in these cases. One implant became mobile 4 weeks after loading because of a moment of force that was too large. In one patient both implants were lost because of peri-implant inflammation. The other 16 implants were subjected to orthodontic loading for a period of 10.2 months (SD +3.5 months) without any peri-implant reaction or mobility.
CONCLUSION: The InPlant™ system offers a simple surgical procedure with easier orthodontic handling also in growing patients. They can be indirectly loaded after insertion with a force up to 300 cN. Orthodontic implants keep treatment planning and therapy simple. Because of the possibility of maximal anchorage the implants may bring about changes in orthodontic treatment.

55 EVALUATION OF CEPHALOMETRIC MEASUREMENTS THROUGH REPRODUCTION OF TRACINGS

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AIM: To evaluate the reliability of cephalometric measurements through the reproduction of tracings.
MATERIALS AND METHOD: Thirty radiographs of subjects aged from 13 to 17 years from the archives for the Specialization in Orthodontics. These received identification tags and were sent to be measured using a computer, a scanner, and software with image modification. The evaluated cephalometric readings were SNA, SNB, SNGOM, 1.SN, 1.NA, 1–NA, 1.NB, 1–NB, 1.1, FMA. The results were archived and 15 days after the identification tags were changed and sent again to the same professional to undertake the same analysis. This procedure was conducted twice, making a total of four registrations without the person knowing he was evaluating the same radiographs. A statistical test was applied (variant analysis) and the variation mean and percentage from the measurements were determined.
RESULTS: The variation results were: SNA –2.2° (2.73 per cent), SNB –1.8° (2.3 per cent), SNGOM –1.7° (4.3 per cent), 1.SN –2.8° (2.71 per cent), 1.NA –1.6° (6.89 per cent), 1–NA –1.8 mm (39.13 per cent), 1.NB –3.6° (13.71 per cent), 1–NB –0.8 mm (16.33 per cent), 1.1 –4.7 (3.69 per cent) and FMA –2.4° (8.78 per cent).
CONCLUSIONS: Measurements that used point A, the incisors, and the Frankfort Plane were those that showed the largest variation in reproduction. These results demonstrate that careful interpretation is required for 1–NA in orthodontic diagnosis because of the high variation of the identification of the structures for reproduction. The FMA variation was twice that of SNGOM, a major factor to be considered in cephalometric diagnosis.

56 SYNCHROTRON-BASED MICROTOMOGRAPHY OF ALVEOLAR SUPPORTING TISSUES

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AIM: For estimation of stress on the alveolar bone due to an orthodontic loading regime, the alveolar surface is inherently assumed to be smooth and continuous. The validity of this assumption was scrutinized by performing ultra-high resolution micro-computed tomographic scans of the alveolar support tissues and subsequent three-dimensional (3D) reconstruction.
MATERIAL AND METHOD: Samples of the root, periodontal ligament (PDL) and alveolar bone complex from a human, monkey, and pig were harvested and scanned with a synchrotron-based microtomograph at the DORIS-ring situated at the Hasylab. Scans were made at 7-micron spatial resolution. Because synchrotron radiation is monochromatic, no beam-hardening artefacts can occur and the grey-values in the scans were therefore directly related to the local tissue densities. Apart from visualizing the mineralized tissues, the beam energy was sufficiently low to allow for the visualization of soft tissues such as the fibres of the PDL and blood vessels.
RESULTS: The boundary between cementum and dentine of the roots could be observed very clearly, due to the higher porosity and lower mineralization of the former. Also the orientation of the fibres of the PDL could be seen. The surface of the alveolar bone turned out to be very rough and sharply edged, which became particularly clear in the 3D reconstructions of the alveolar surface. An intricate network of marrow cavities and blood vessels cut their way through this surface. Differences in the local grey-value distribution also pointed to bone remodelling activity close to the PDL.
CONCLUSION: Unlike the outer surface of the root, the surface of the alveolar bone is very rough and uneven. The assumption that it is smooth and continuous therefore does not hold true. This means that even small orthodontic loads can give rise to high local stresses and strains in the bone and thus initiate remodelling processes.

57 MORPHOLOGICAL CHARACTERISTICS OF SKELETAL OPEN BITE

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AIM: To determine certain morphological characteristic that are specific to skeletal open bites.
SUBJECTS AND METHOD: Thirty patients with skeletal open bites (15 males, 15 females) as well as 30 individuals with normal occlusion. A profile radiograph using standard methods was obtained for all 30 patients. The subjects were selected following intra- and extra-oral examination and further selection was made based on the relevant indicators for the basal angle that is formed by the maxillary and mandibular planes. Ten angular and seven linear parameters were measured, through which the facial rotation and skeletal structures of the head and face were determined. The parameters that showed statistical significance will be of assistance in further evaluation of skeletal open bites.
RESULTS: The angles of the facial axis NBa/PtGn and the mandibular curve were reduced in patients with a skeletal open bite. Significantly increased changes in Go and basal angles indicated posterior rotation. The lower face height angle, SNA–Xi–Pm, showed a significant increase. Lower face height (SNA–Gn) and mandibular length were also increased.

58 THE EFFECT OF RAPID MAXILLARY EXPANSION ON CONDUCTIVE HEARING LOSS

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AIM: To investigate the effect of rapid maxillary expansion (RME) on conductive hearing loss.
SUBJECTS AND METHOD: Ten patients (six females, four males) with an age range of 9 years 7 months to 17 years [mean age 13.98 years (SD = ±2.25)] all with a maxillary skeletal posterior crossbite and conductive hearing loss without intervention agents, e.g. otosclerosis, otitis media, etc. Three audiometric records were taken from subjects using a pure tone test: the first before RME, the second after mid-palatal suture opening (mean 15.83 days), and the third after a fixed retention period (mean 4 months). All RME appliances were constructed by one technician and activated by one orthodontist. The audiometric records were taken by an audiologist using the same instrument and assessed by an otolaryngologist. Changes in hearing level thresholds for both air- and bone-conduction and also air-bone-gap for each ear were registered separately and evaluated with a paired *t*-test between the recording times. A Eustachian Tube Function Test (ETFT) was taken from each patient and compared between the recording times.
RESULTS: There was an improvement in hearing level thresholds between the first and second and the first and third recordings (125–8000 Hz) for both air- and bone-conduction and also air-bone-gap, which was statistically significant. The improvements in hearing remained stable after the fixed retention period. ETFT showed a normal opening function of this tube during these periods (active and retention).

59 THE EFFECT OF CHEWING GUM USE ON BOND FAILURE OF FIXED ORTHODONTIC APPLIANCES

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AIM: To investigate the influence of gum chewing habits on damage to full fixed orthodontic appliances.
SUBJECTS AND METHODS: Forty-eight adolescents (mean age 13 years) were bonded and banded with full fixed appliances by an experienced orthodontist. These cases were monitored over a 3-month period for loss of brackets or bands and wire distortion, starting 3 months after placement of the appliances. Thirty-two patients (606 teeth) were randomly assigned to use two pieces of prescribed sorbitol chewing gum during a 10-minute period, twice a day. Sixteen subjects (293 teeth) served as the control group in which gum use was prohibited.
RESULTS: The gum-free control group showed a minor rate of bond failure (1.71 per cent). A statistically non-significant lower score ($P < 0.05$) was recorded in the study sample (1.65 per cent). Dividing this sample based on sagittal skeletal typology showed that significantly more brackets were lost in subjects with a Class II malocclusion (2.33 per cent). Bond failure occurred predominantly at the enamel/adhesive interface. The general profile of a destructive patient seems to be a Class II normodivergent extraction case with open lip posture, but with normal treatment compliance. Neither loss of molar bands nor wire distortion was detected. Therefore, these parameters were discarded from the protocol.
CONCLUSION: Regular use of chewing gum seems to be harmless to fixed orthodontic appliances, except in certain Class II subjects, and therefore can be recommended in the prevention of decalcification and maintenance of a beneficial level of oral hygiene.

60 THE PREVALENCE OF TEMPORO-MANDIBULAR DYSFUNCTION IN 6–19-YEAR OLD TURKISH CHILDREN

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AIM: To determine the prevalence of temporomandibular dysfunction (TMD) in Turkish 6–19-year-old individuals.
SUBJECTS AND METHOD: Nine hundred and sixty-five subjects (472 boys, 493 girls) with a mean age of 12.9 years. Subjective symptoms of pain in the temporomandibular joint (TMJ) area on waking, during palpation, pain in masticatory muscles, pain upon closing the jaw, headache, and locking and objective symptoms of clicking, crepitation,

limitation in opening and closing, deflection, and deviation were evaluated. The relationship between genders was assessed using a Chi-square test and appropriate statistical analysis.
RESULTS: Three hundred and five children (31.61 per cent) were symptom free. Six hundred and sixty children (68.39 per cent) had at least one or more TMD symptoms. The prevalence of TMD symptoms was higher in girls than boys ($P < 0.001$). Regarding signs and symptoms, 23.8 per cent ($n = 230$) had clicking; 8.5 per cent ($n = 82$) had crepitation; 1.5 per cent ($n = 14$) had limited mouth opening; 0.8 per cent ($n = 8$) had locking; 6.7 per cent ($n = 65$) had pain in the TMJ area in the morning; 7.4 per cent ($n = 71$) had pain on palpation; 16 per cent ($n = 154$) had pain in the masticatory muscles; 47.8 per cent ($n = 461$) had headaches; and 5.9 per cent ($n = 57$) had pain during jaw movements. As for deviation and deflection, 6.8 per cent ($n = 66$) had deviation and 5.4 per cent ($n = 52$) deflection. One of the most significant results was the high prevalence of headaches in 6–19-year-old Turkish children.
CONCLUSION: This group of Turkish children were found to be highly prone to TMD. The children in this age group can be considered as potential TMJ patients as the main reason for common headaches seems to be TMD; however, further medical investigations should be performed to reveal other factors that may cause headaches.

61 BRUXISM AND MASTICATORY MUSCLE PAIN—AN EPIDEMIOLOGICAL STUDY

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AIM: To evaluate the relationship between bruxism and masticatory muscle pain in Turkish children.
SUBJECTS AND METHODS: Seven hundred and sixteen subjects (355 boys, 361 girls) between 10 and 19 years of age (mean 14 years 8 months). Following clinical examination and anamnesis, the subjects were divided into two groups, bruxers and non-bruxers. Pain on palpation of the masseter and temporalis muscles was registered and a functional examination of the lateral and medial pterygoid muscles was carried out. The relationship between bruxism and muscle pain was evaluated using the Chi-square test.
RESULTS: In all subjects there was a relationship between bruxism and medial pterygoid and temporalis muscle pain ($P < 0.005$). A meaningful relationship was observed between bruxism and pain in the masseter, temporalis, and lateral pterygoid muscles ($P < 0.05$), and pain in the medial pterygoid muscle ($P < 0.005$). No relationship was found between bruxism and the examined muscles in girls.
CONCLUSION: The relationship between bruxism and masticatory muscles is an expected result and may be a predisposing factor for temporomandibular disorders. Early diagnosis and treatment of bruxism may be useful in young people.

62 COMPARISON OF TWO MAXILLARY RETENTION REGIMES

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AIMS: To compare incisor contact point relapse between a 6 month and a 1 year maxillary retention regime with Hawley retainers.
SUBJECTS AND METHODS: Group 1 (3 months full-time, 3 months night only) consisted of 20 patients (five males, 15 females) and Group 2 (6 months full-time, 6 months night only) 18 patients (six males, 12 females). The age range at the start of treatment was 11–19 years. All had a Class I or Class II incisor relationship and were treated with straightwire appliances by two orthodontists. The irregularity index (Little, 1975), intercanine width, intermolar width, and arch length were recorded for the maxillary arch with digital callipers at the start of treatment (T1), debond (T2), end of retention (T3), and 3 months out of retention (T4).
RESULTS: Maxillary incisor alignment relapsed an average of 43 per cent in Group 1, while Group 2 showed a 2 per cent relapse. Clinically, the additional improvement conferred by the longer retention regime translated into an absolute value of 1.8 mm. Relapse of incisor irregularity did not correlate significantly with changes in arch parameters. Extraction and non-extraction arches did not behave differently.
CONCLUSION: On average, retaining a case for 1 year rather than 6 months is clinically beneficial and reduces relapse.

63 THREE-DIMENSIONAL PALATAL SIZE AND SHAPE IN HEALTHY CHILDREN AGED 4–6 YEARS

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AIM: To measure age-related modifications in three-dimensional (3D) hard tissue palatal size and shape in healthy children.
SUBJECTS AND METHODS: Hard-tissue palatal dimensions and shape in 31 children, 4–6 years of age, all with a complete primary dentition, and free from respiratory problems, were analysed from dental casts. Palatal landmarks were digitized with a computerized 3D instrument, and their coordinates used to derive a mathematical model of palatal form. Palatal shape (size-independent) was assessed by fourth-order polynomials in the sagittal (from the incisive papilla to a line connecting the second deciduous molars) and frontal plane (a curve corresponding to the second primary molars) projections. For each palate, the following measurements were obtained: in the sagittal plane: palatal length, slope, and maximum height; in the frontal plane: palatal width and maximum height at the second primary molars. Dimensions were compared between ages by factor analyses of variance.
RESULTS: A significant effect of age was found for palatal slope (sagittal plane), maximum height (sagittal and frontal

planes). Palatal length and width did not change. Maximum height in the sagittal plane was 9.9 mm at 4 years, 10.6 mm at 5 years, and 11.5 mm at 6 years. Similar values were found for maximum height in the frontal plane. Between 4 and 6 years of age hard tissue palatal shape (size-standardized) also altered, and the palate became higher in both the frontal and sagittal planes.
CONCLUSIONS: The significant increase in palatal height (both size and shape) together with a lack of modification in width and length should be taken into consideration when planning early orthodontic treatment (rapid palatal expansion) in children with a complete primary dentition.

64 TREATMENT TIME IN LINGUAL AND LABIAL TECHNIQUES

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AIM: To compare the treatment times needed for lingual and labial orthodontic techniques on the basis of treatment outcome evaluated retrospectively.
SUBJECTS AND METHOD: One hundred adult patients, aged 18–73 years, selected from those treated over a 20 year period, were divided into two groups according to the technique used: 50 lingual and 50 labial. Pre- and post-treatment models, photographs, and radiographs were compared in order to analyse the dento-alveolar movements and interarch relationship in the three dimensions of space. The time needed for achieving the results in both lingual and labial techniques was checked and statistically evaluated by a Student's *t*-test during the various phases of treatment: (1) denture preparation; (2) denture correction; (3) denture completion; (4) finishing; (5) retention.
RESULTS: The total time for accomplishing treatment was 13.5 months for the lingual and 24.7 for the labial technique (retention excluded) ($P < 0.05$). The mean time required for denture preparation in the lingual technique was 2.3 months, which was significantly shorter than for the labial technique of 6 months ($P < 0.05$). No significant differences were found between the times employed for denture correction, which was approximately 4 months for both techniques. The mean time needed for denture completion (lingual 4.9 and labial 8.7 months) and finishing phase (lingual 2.3 and labial 6 months) showed significant differences ($P < 0.05$). The retention time was about 12 months for both techniques.
CONCLUSIONS: Dento-alveolar movements in the three dimensions of space require less time using the lingual technique. The results achieved emphasize the main characteristics of lingual biomechanics in which forces from different origins act together.

65 SAGITTAL SKELETAL RELATIONSHIPS IN UNILATERAL CLEFT LIP AND PALATE CHILDREN COMPARED WITH A NON-CLEFT POPULATION

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AIM: To compare the sagittal skeletal relationships of operated unilateral cleft lip and palate (UCLP) patients with non-cleft children. The treatment protocol used was designed to create conditions to achieve a correct resting posture of the oral cavity, which is mandatory for normal dento-facial development.
SUBJECTS AND METHOD: Twenty-six Caucasian children aged 6–12 years who met the following criteria: complete UCLP with no other congenital anomalies; 5–6 months of pre-operative orthopaedics with a passive plate and external non-elastic strapping; definitive lip repair at 6 months of age, soft palate repair at 12 months, and hard palate repair at 30 months, no post-operative orthodontics. The resting posture of the oral cavity was determined clinically. To assess the sagittal skeletal relationship, lateral cephalograms were taken. Measurement of SNA, SNB, ANB, and Wits appraisal was carried out. The values of the measurements were compared with the standard values of non-cleft children proposed by Droschl and Jacobson.
RESULTS: Seventeen children achieved a correct resting posture of the oral cavity. The sagittal relationship between maxilla and mandible was normal in 17 subjects. A distal relationship was found in seven patients and mesial in two subjects. The values of Wits appraisal were within the normal range of the mean value ± 1 SD in 15 cases, above normal in nine subjects and below normal in two patients.
CONCLUSIONS: UCLP patients can achieve a normal skeletal relationship in the mixed dentition by following the described treatment protocol.

66 SKELETAL TREATMENT RESPONSE RELATED TO THE AMOUNT OF MANDIBULAR ADVANCEMENT WITH FUNCTIONAL APPLIANCES

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AIM: To investigate the sagittal treatment response to standardized mode and various amounts of advancement of the mandible in functional appliance therapy.
SUBJECTS AND METHOD: Twenty-one consecutive patients (13.2 ± 1.5 years of age) with a skeletal Class II malocclusion treated with a splinted headgear Herbst appliance and step-by-step advancement of the mandible. Initially the mandible was advanced 2 mm and thereafter another 2 mm every 2 months. The total activation varied

from 8 to 16 mm. Headgear was used 10–12 hours/day and the applied force was 400–500 grams. Compliance was good in all patients. Lateral cephalograms were obtained at the start and end of treatment, and were analysed according to Pancherz (1982). When the final cephalogram was obtained the patients had been under treatment for 12.2 (SD 0.11) months.
RESULTS: The improvement in jaw base relationship was 5.6 ± 1.3 mm ($P < 0.001$) and the range was 2.9 to 13.8 mm. The maxilla moved –0.6 ± –0.8 mm ($P < 0.01$) and the range was –5.5 to +1.4 mm. The mandible came forward 5.0 ± 2.4 mm ($P < 0.001$), and the range was 0.3 to 15.2 mm. The correlation coefficients between the amount of mandibular advancement and the change of jaw base relationship, mandibular base, and maxillary base were –0.30 (ns), 0.41 (ns), and 0.48 (ns), respectively.
CONCLUSION: The difference in the amount of mandibular advancement in the interval investigated seems not to be related to the actual sagittal skeletal response. It appears that there is a minimum threshold level required for an advancement to solicit a skeletal response.

67 COMPARISON OF RADIOGRAPHIC AND PHOTOGRAPHIC MEASUREMENT OF MANDIBULAR ASYMMETRY

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AIM: To compare the measurements of mandibular asymmetry by digitization of mandibular outlines from standardized facial photographs and postero-anterior (PA) cephalograms.
MATERIAL AND METHOD: Using an on-screen digitizing programme, four ratios were used in calculating asymmetry: area (relative size of right/left mandibular segments), perimeter or length of outlines, compactness (shape), and moment. The records of 28 patients with varying degrees of asymmetry were used.
RESULTS: Close correlations were found for three of the ratios (area, compactness, and moment) between measurements from photographs and cephalograms. A further comparison identified that measurements from the cephalograms correlated more closely with those from photographs when the mastoid processes were used as a baseline, rather than latero-orbitale. Repeatability of mandibular outline digitization proved satisfactory.
CONCLUSIONS: Whilst digitization from standardized photographs remains the preferred approach, the results indicate that the PA cephalogram could be used in similar fashion. Unlike other PA analyses for mandibular asymmetry, this method avoids problems of landmark identification, thus presenting a clinically useful method of quantifying asymmetry, for example in auditing the surgical-orthodontic correction of asymmetry, or monitoring change over a period of time.

68 CHANGES IN LIP VERMILION HEIGHT AFTER ORTHODONTIC TREATMENT

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AIMS: One of the goals of orthodontic treatment is the achievement of a good appearance. The purpose of this study is to determine the effects of different orthodontic treatment (with or without extraction and retraction of anterior teeth) on lip vermilion position and the profile after treatment.
SUBJECTS AND METHOD: Thirty boys and girls aged 16–17 years with Class I, II, and III malocclusions (dental or skeletal) who had undergone different orthodontic treatments. They were divided into extraction and non-extraction cases and were compared with each other. Rain, Perkins and Staley's analyses for changes of lip position were used. The reference lines and planes used were: the E-line, conventional Frankfort horizontal plane (CFH), and VPL perpendicular, which was drawn perpendicular to CFH plane at S (sella) point. The soft tissue reference points were: Ss, Ls, no, Li, Si, Pog′, STO′, and STO′; and hard tissue reference points: S, N, UIP, and LIP. Nasolabial and mentolabial angles were also used. From each point a perpendicular line was passed to the VPL line and was measured as the horizontal parameter. The various distances between these lines were measured as vertical parameters. The distance between Ls and Li points to E-line was also measured. The measurements from the pre- and post-treatment cephalograms were compared in each case to evaluate the final positions of the soft tissues.
RESULTS AND CONCLUSIONS: Comparison between the extraction and non-extraction cases showed that generally the changes in extraction cases were greater than in non-extraction cases. The position of the lips can be affected by different factors, such as orthodontic treatment or growth of the nose and chin. Growth of the nose and chin had a greater influence on the position of the lips compared with retraction of the anterior teeth.

69 TREATMENT OF A CLASS II DIVISION 1 VERTICAL GROWTH PATTERN WITH A MODIFIED FUNCTIONAL APPLIANCE

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AIM: To investigate the effect of a modified functional appliance on the vertical growth of skeletal Class II patients.
SUBJECTS AND METHODS: Twenty patients (average age 10.5 years) with a Class II division 1 malocclusion due to mandibular deficiency and a vertical growth pattern. All patients were treated with a modified functional tooth and tissue borne appliance. This functional appliance was designed with an increased posterior bite block height to have muscular activity in the rest position. The functional therapy lasted for 1 year.
RESULTS: The treatment was significantly successful in co-operative patients. The cephalometric data showed that the

vertical growth pattern change was in favour of Class II correction.
CONCLUSION: In a previous study the mechanism of Class II correction using functional appliances was shown to hold the mandible actively in a forward position. In this situation the protractor muscles are active and prevent retractor muscle activity. This caused a headgear effect and undesirable lower anterior flaring. In this new design the posterior bite block was higher than normal, thus increasing elevator muscle activity, which resulted in retardation of upper and lower posterior dentoalveolar vertical growth. The impaction of the posterior segment of palatal plane might take place. It seems that the increased posterior bite, block pulls the condyle down out of the glenoid fossa more than normal. This will increase the stretch of the lateral pterygoid muscle more inferiorly and less anteriorly, resulting in osteogenic activity in the head of condyle, which increases the vertical length of the ramus. This phenomenon will be in favour of open bite correction due to counter-clockwise rotation of the mandible.

70 MOLAR DISTALIZATION AND ANCHORAGE LOSS IN THE MIXED AND PERMANENT DENTITION USING THE PENDULUM APPLIANCE

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AIM: To determine differences in molar distalization and premolar mesial movement (as anchorage loss) using the Pendulum appliance anchored on primary and permanent teeth.
SUBJECTS AND METHOD: Eighteen Class II patients, nine in the full early permanent dentition (mean age 11.8 years) and nine in the mixed dentition with at least the second deciduous molar present (mean age 9.1 years). Treatment involved a comprehensive stage of upper molar distalization with a standard Pendulum appliance. The treatment was led by the same operator (mean treatment time 27 weeks), using Class II elastics in all subjects to reduce premolar mesial drift. The treatment monitoring was under the control of the same author. A new method to evaluate upper molar distalization was used: dental casts were obtained for each case before Pendulum activation and after molar distalization. Each stone model was digitally scanned, printed, and traced in order to analyse distal molar and premolar mesial movement (millimetre evaluation) and to evaluate molar rotation. Values obtained for the two groups were compared and statistically analysed using *t*-tests and ANOVA to assess the differences in appliance effectiveness, i.e. whether the Pendulum was anchored on the primary or permanent teeth.
RESULTS: Upper molar distal movement and molar rotation were not statistically different in the two groups ($P > 0.5$). Anchorage loss was found to be statistically different ($P < 0.05$), less in the mixed dentition group. Cross-linking these results with treatment time (ANOVA), the differences between the groups persisted.
CONCLUSIONS: Primary teeth appear to be more useful for dental anchorage in molar distalization with fixed maxillary appliances. Second molar anchorage did not affect the amount of distal molar movement, even cross-linked with treatment time.

71 MODE OF BREATHING AND MANDIBULAR SHAPE: A PRIMATE STUDY

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AIM: To present findings on the relationship between continuous mouth breathing and mandibular shape in *Macaque* primates.
MATERIAL AND METHOD: From the available pool of published data, a subset of monkeys was selected. The criteria for selection were the same species, juvenile to early adolescent, and all surgically obstructed monkeys who changed their mode of breathing to mouth breathing by continuous vertical re-posturing of the mandible. In contrast to previous investigators who compared such groups with cephalometric techniques, more recent methods developed to compare shapes of objects (independent of their size, rotation, and position) were used. Statistical testing of differences between Procrustes derived mean shapes at the beginning and end of the experiments were calculated for particular mandibular regions in the control and experimental populations.
RESULTS: No statistical differences in the mean mandibular shapes of the unobstructed and obstructed primates were found in the regions studied.

72 CROWDING/SPACING IN THE DENTAL ARCHES IN RELATION TO THIRD MOLAR STATUS

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AIM: To study the occurrence and extent of spacing and crowding in the dental arches in relation to eruption, impaction, or agenesis of third molars (M3).
MATERIALS AND METHOD: Study casts and cephalometric head films from 42 subjects with all M3s erupted, 35 subjects with all M3s impacted, and 27 subjects with all M3s congenitally missing. The subjects were adults and none of them had undergone orthodontic treatment. Tooth widths and dental arch circumference were measured using digitizing equipment with a precision of 0.1 mm. On the basis of these data, the space conditions in the dental arches of the three groups were calculated and compared. Jaw size, as measured on the head films, was also included in the analysis.
RESULTS: Tooth size in the impacted group was significantly greater than that in the erupted and agenesis groups. The individual values of crowding/spacing exhibited considerable variation in the three groups. The impacted group presented significantly ($P < 0.05$) more crowding in the upper arch than the agenesis group; otherwise the differences between the groups were small and not significant.

CONCLUSION: The presence or absence of M3s *per se* does not seem to influence the variables crowding/spacing to any significant degree. Tooth and arch size are presumably factors of greater importance in this context.

73 EARLY INFORMATION AND SUPPORT TO PARENTS OF INFANTS WITH CLEFT LIP AND PALATE

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AIM: The changes in working methods used by the cleft lip and palate (CLP) team at the University Hospital, Linköping, Sweden were evaluated. Before 1997 the CLP team saw the patient for the first time at 3 months of age. In 1997 new routines were introduced. Within 1 week after the child's birth, the CLP team arranges to meet the family. The parents will then meet the CLP nurse. Different educational initiatives have been undertaken to improve collaboration between the CLP team and the health care providers in the home district. The aims of this study were to determine whether parents of children with CLP defects feel that support and information has changed and to assess how parents rate co-operation with the CLP team and with the district health care providers.
MATERIAL AND METHOD: Three questionnaires were sent to parents and health care providers in the south-east health care region of Sweden. The first was sent to the parents of the routine before 1997 (n = 33) and the second questionnaire to parents with children born after 1998 (n = 23). The third questionnaire in 1999 was designed for the health care providers (n = 26).
RESULTS: The support since 1997 had improved. The quality of information given to the parents also appeared to be better and more suitable to the situation. One important finding was that someone who had sound knowledge in the subject field gave the information at the right time. Parents often desired information on practical problems such as breast-feeding and pacifiers. The health care providers felt that co-operation with the CLP team had developed in a positive direction.
CONCLUSION: The CLP team's new method of working seems to be a significant improvement in the areas of information and increased the sense of security of both the parents and health care personnel.

74 CLINICAL RELIABILITY OF BONDED CANINE-TO-CANINE GLASS FIBRE RETAINERS

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AIM: Bonded orthodontic retainers constructed from composite and multistrand wire provide an efficient system for long-term retention. Transparent fibre systems that claim to present a tooth-coloured and aesthetic alternative to wire retainers are currently being introduced onto the dental market. The aim of the study was to investigate the clinical reliability of a resin-reinforced glass fibre splinting system to prevent post-treatment changes.
MATERIALS AND METHODS: Thirty-seven patients participated in the study. Following the manufacturers' instructions, lingual enamel surfaces were etched with phosphoric acid gel (37 per cent, 20 seconds). Unidirectional fibre strips with a width of 3 mm (Splint-It®, Jeneric Pentron, USA) were directly bonded with a flowable resin composite (Durafill Flow®, Heraeus Kulzer, Germany). Plaque accumulation, calculus along the gingival margin, gingival inflammation (BOP) and pocket probing depths were scored at baseline and at follow-up examinations during the 9-month observation period. Retainer failures were recorded and a Kaplan–Meier survival analysis was performed.
RESULTS: There was a significant increase in plaque accumulation, calculus, BOP, and probing depths (one-sample t-test, $P < 0.05$) during the 9-month observation period. Failures were observed in 19 patients, corresponding to a retention rate of <50 per cent.
CONCLUSION: Due to their limited clinical reliability and negative periodontal effects, unidirectional glass fibre strips cannot be recommended for bonded canine-to-canine retainers.

75 IS THERE AN EVOLUTION IN THE AESTHETIC PERCEPTION OF THE FACE?

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AIM: To verify whether facial anthropometric standards, as proposed by Farkas still 'fit' the modern aesthetic perception.
MATERIAL AND METHODS: The answers of 80 observers (40 'experts', 20 maxillofacial surgeons with at least 10 years clinical experience, and 40 'non-experts') who assessed modified images of four normal Caucasian models (two males, two females) with a normal facial anthropometric aspect to determine aesthetics were analysed. The photographs were modified using a computer program so that the images were characterized by the high (excess) and low (defect) limit of normality in seven aesthetic parameters. Vertical plane: (1) Sn–Gn (lower face height); (2) Sn–Sto (upper lip height); (3) Sto–Gn (lower lip and chin height). Sagittal plane: (4) Ulv (upper lip vermilion to subnasal vertical); (5) Llv (lower lip vermilion to subnasal vertical); (6) Pog (chin to subnasal vertical); (7) Bimax. (bimaxillary complex to glabella vertical). Twenty-one photographs of each model (three per parameter: normal, excess, defect) were obtained.
RESULTS: Statistically significant variations were found between the assessments of the experts and non-experts and Farkas' standards. However, the anthropometric standards proposed by Farkas still describe a well-balanced face. Yet, even if all images 'in defect' were strongly rejected, some parameters 'in excess' were accepted as well as, or more, than the normal ones, especially by the non-expert group: (1) Pog and Bimax in both sexes; (2) Ulv in females; (3) Sn–Gn, especially in males.

CONCLUSION: In treatment planning of an orthodontic-surgical patient, the cephalometric standards must be accurately evaluated. Care must also be taken not to create any defect in the sagittal and vertical parameters. In some subjects a mild excess may be planned.

76 CHANGES IN THE mRNA OF CONTRACTILE PROTEINS IN THE MUSCLE AFTER COMBINED ORTHODONTIC-SURGICAL TREATMENT

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AIM: Orthodontic and surgical treatment leads to muscle stress and polymorphic expression of myosin heavy chains (MyHC). The aim of this study was to evaluate the effects of treatment on the resistance to fatigue of the masticatory muscles.
MATERIAL AND METHODS: Ten healthy adult patients who had undergone orthodontic treatment in combination with surgery were divided into two groups (Class II and Class III malocclusions). The muscle samples from the anterior and the posterior part of the right and left side of the masseter were taken during (T1) and 6 months after surgery (T2). A highly sensitive method of quantitative polymerase chain reaction (PCR) was established to study the mRNA isoform expression in muscle fibres. The PCR products were cloned into pGEMT easy vector, sequenced, and identified as type I and type IIx/d MyHC isoforms corresponding to accession numbers NM 000257 and AFI1 1785.
RESULTS: Treatment of a Class II malocclusion led to a significant decrease ($P < 0.01$) in the level of type I and type IIlx/d mRNA of MyHC in the anterior part of the masseter. The decrease of mRNA in the anterior part was combined with a lower decrease in the posterior part. The treatment of Class III malocclusions led only to a decrease of mRNA in the posterior part of the masseter (type I $P < 0.01$ and type IIx/d $P < 0.05$).
CONCLUSION: The treatment process in human muscle is accompanied by a modification in muscle phenotype. Combined orthodontic and surgical treatment was found to show good occlusal stability but led to large muscle atrophy or improved use of muscle power. It can be concluded that the PCR method used for measuring MyHC content is a valid alternative for muscle diagnosis in humans as it is less expensive and time-consuming. The PCR method offers new prospects for application in orthodontic and maxillo-facial surgery studies.

77 MANDIBULAR TORSION, BAROPODOMETRIC ANALYSIS, AND CERVICOBRACHIAL PAIN IN ADULTS: PATHOPHYSIOLOGICAL ANALYSIS

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AIM: To analyse the relationship between mandibular torsion, bipodalic load, and the onset of cervicobrachyalgia by analysing the muscular activity and creating a physio-pathological pattern.
SUBJECTS AND METHOD: Sixty-two adults (24 males, 36 females, average age 38.45 years, standard deviation 11.02 years, range 24–61) were chosen, all suffering from mandibular torsion. Exclusion criteria: subjects with past mechanical trauma, who underwent surgical procedures or were being treated with psychotropic drugs. The subjects were studied with the Physical Gait Software® baropodometric platform, in order to identify the distribution of podalic loads. The mandibular movement was analysed through kinesiographic examinations (Biotronic® srl). The electro-myographic (EMG) analysis was carried out bilaterally on the masseter, temporal, sternocleidomastoideus, trapezium, and front scalenus muscles.
RESULTS: All subjects showed a pressure overload on the backfoot in the opposite side affected by torsion (or rather, homolaterally to the side with a reduction in the vertical dimension), with a load on the forefoot on the side affected by torsion, and an obliquity of the body axis. EMG showed an asymmetrical contractural condition of the muscles in question, with hypertonia of the front scalenus. Using a mandibular repositioning wax shaped in order to eliminate the torsion, the podalic loads were symmetrically distributed, with the normal physiological heel load.
CONCLUSIONS: The baropodometric platform allows diagnosis of a postural pathology caused by an alteration in the cranio-mandibular relationship. In particular, mandibular torsion induces body torsion through asymmetrical activation of the crossed muscular chains. This induces the spasm of the scalenus muscles, with first rib superiority, pain in the lateral neck region, compression of the lower part of the brachial plexus, and onset of arm pain and paresthesia in the distribution territory of the ulnar nerve.

78 THE EFFECT OF FACEMASK THERAPY ON THE CRANIOFACIAL COMPLEX

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AIM: To examine the changes that develop as a result of facemask therapy in skeletal Class III subjects.
SUBJECTS AND METHOD: Two groups were studied. Group I consisted of 34 children with skeletal Class III malocclusions treated with a facemask until a satisfactory maxillary position was established and there was a positive overjet. Group II comprised the control group, and included 46 children with a skeletal Class III malocclusion who had not undergone orthodontic treatment. This group was used to evaluate apparent changes as a result of natural growth and the effects of orthodontic treatment. Lateral cephalograms of patients in group I (before and after treatment) and group II were analysed. The parameters from group I were measured before and after treatment, and significant differences were calculated using a paired *t*-test. The same procedure was repeated for the control group.

Wilcoxon's test was used to statistically evaluate the treatment effect as a result of natural growth or outcome of facemask therapy.
RESULTS: Analysis of the dento-alveolar, skeletal, and facial two-dimensional changes showed an increase in SNA of 1.24 degrees, and in ANB of 2.12 degrees (Wilcoxon test $P < 0.001$), an increased maxillary length of 1.67 mm, a decrease in SNB of –0.77 degrees, and Go angle –0.24 degrees (Wilcoxon test $P < 0.001$), and an increased overjet of 4.76 mm ($P < 0.001$) in Group I.
CONCLUSIONS: Lateral cephalograms of patients treated with facemask therapy showed an increased maxillary prognathism, gonial angle, and anteroposterior jaw interrelationship, correction of the anterior crossbite, a decrease of angle of mandibular prognathism, and retroposition of the lower anterior teeth.

79 MAGNETIC RESONANCE IMAGE EVALUATION OF THE RELATIONSHIP BETWEEN TEMPOROMANDIBULAR JOINT COMPONENTS IN ASYMPTOMATIC CLASS III PATIENTS

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AIM: To investigate on magnetic resonance images (MRI) the disc position according to the condyle, and condyle position according to the glenoid fossae in asymptomatic skeletal and dental Class III young adults.
MATERIAL AND METHOD: Thirty-four MRIs of bilateral sagittal temporomandibular joints (TMJ) obtained from 17 asymptomatic subjects with skeletal and dental Class III malocclusions in the closed mouth position. Lateral head films were used to describe the skeletal features. Linear and angular measurements were carried out on the right and left sagittal TMJ MRIs. Disc position in relation to the condyle was measured both linearly and angularly. Proportional measurements, which included anterior and posterior joint space, were utilized to determine the condyle location relationship with the glenoid fossae. Angular measurements of eminence steepness and condylar morphology were also undertaken. Descriptive statistics of right and left TMJ measurements were determined. Variables of the right and left TMJs were compared with a Student's *t*-test. The correlation coefficient of these variables was calculated.
RESULTS: It was found that the right condyle was positioned backward in the glenoid fossa and the left condyle was concentric in these asymptomatic Class III young adults. The disc tended towards an anterior position in both the right and left TMJ relationship with the condyle, although the cases were selected as being clinically symptom free.
CONCLUSION: The relationship between disc and condyle in the TMJs should be considered before orthodontic and/or orthognathic surgery in young adult Class III subjects. This determination is crucial for a reduction of TMJ internal derangement.

80 EFFECTS OF CLASS II TREATMENT WITH QUADRILATERAL PREMOLAR EXTRACTIONS ON THIRD MOLAR ERUPTION

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AIM: To examine third molar eruption in Class II patients treated by extraction of upper and lower first premolars.
MATERIAL AND METHOD: Sixty lateral cephalograms and panoramic films obtained at the beginning and end of treatment from Class II division 1 malocclusion cases treated with extraction of four first premolars. Maxillary and mandibular dentoalveolar measurements were carried out on the cephalograms. Panoramic film evaluation was performed to predict maxillary right-left and mandibular right-left third molar eruption. Changes occurring during the treatment phase were analysed by paired *t*-tests. Correlations between cephalometric and panoramic values were evaluated.
RESULTS: Maxillary incisor retrusion and maxillary and mandibular molar mesial movement were determined ($P < 0.01$). Lower incisor protrusion and lower molar mesialization showed a positive correlation with lower right third molar uprighting ($r = 0.480$, $P < 0.01$, $r = 0.484$, $P < 0.01$, respectively). Upper right third molar position showed a negative correlation with lower molar position ($r = 0.566$, $P < 0.05$). The upper left third molar position was positively correlated with lower incisor position.
CONCLUSION: The possibility of all third molars erupting may be increased in subjects with a Class II malocclusion treated with extraction of four premolars.

81 DOES THE MONOBLOC CAUSE AN EFFECTIVE MANDIBULAR LENGTH INCREASE?

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AIM: To investigate whether or not the monobloc causes an effective mandibular length increase.
SUBJECTS AND METHOD: Twenty-nine patients (mean pre-treatment age 12.17 ± 1.48 years) with Class II division 1 malocclusions randomly selected from a total group successfully treated with an Andresen-Activator. The control group comprised 16 Class II division 1 subjects (mean age at the beginning of the investigation 13.82 ± 1.65 years). The observation period for the control subjects was the same as the treatment group. Anterior cranial base and mandibular superimpositions were performed on 45 lateral cephalograms with the teeth in habitual occlusion obtained before and after the treatment/control period of 1.2 years. The mandibular variables were measured according to vertical and horizontal references lines after superimposition, and changes were analysed by Student's *t*- and paired *t*-test in both groups.
RESULTS: The position of Pogonion and Gnathion changed horizontally forward and vertically downward in the treatment group. Although effective mandibular length (Co–Gn) slightly increased in the treatment group, this increase was

statistically insignificant when compared with the control group.
CONCLUSION: Mandibular position changes in a forward and downward direction with the Andresen-Activator despite there being no change in effective mandibular length. This may be attributed to functional adaptation of the temporomandibular joint elements. However, it may be that mandibular length is indirectly increased.

82 RADIOGRAPHIC EVALUATION OF THIRD MOLARS

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AIM: To statistically assess agenesis and variation in shape, position, root formation, time of development, and path of eruption of the third molars.
MATERIAL AND METHODS: Panoramic radiographs of 250 children aged between 11 and 18 years. All radiographs were examined by two orthodontists who collected data regarding the presence or agenesis of the third molars, the developmental stage, and existing correlation between third molar agenesis and other missing teeth or reduced size and delayed development of teeth. Linear measurements were carried out for the assessment of the level of eruption, crown width, and mandibular third molar space, which is often involved in incomplete eruption or impaction. The results were statistically analysed.
RESULTS: Third molar agenesis affected 18 per cent of the sample and was linked in 38 per cent of the cases with delayed calcification and eruption of lateral teeth. There was also a correlation between third molar agenesis and other missing teeth or impacted third molars in other quadrants.
CONCLUSIONS: Panoramic radiographs are useful for orthodontic diagnosis regarding third molar agenesis and the prediction of eruption or impaction.

83 EXTRACELLULAR MATRIX SYNTHESIS BY MECHANICALLY STIMULATED GINGIVAL FIBROBLASTS

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AIM: To estimate changes of extracellular matrix synthesis by human gingival fibroblasts (HGF) subjected to sustained mechanical stimulation *in vitro*.
MATERIAL AND METHODS: Four HGF cell lines were established, grown to subconfluency in flexible-bottomed multiwell tissue culture plates, and subjected to intermittent stretching in an FX-3000™ Flexercell® Strain Unit. The culture medium was collected and stored for evaluation of extracellular matrix constituents collagens (COL) type I, III, and V, elastin, and tenascin by specific ELISAs. Cell monolayers were used for estimation of cell proliferation using a modified assay kit based on mitochondrial dehydrogenase activity.
RESULTS: A suitable regime of mechanical stimulation (10 per cent strain, 1 Hz, 45 minutes per day for 10 days) was determined empirically in precursor trials by variation of frequency, magnitude, and duration of stimulation. Stimulation caused an increase in COL I, III, tenascin and elastin synthesis, and proliferative activity of stimulated cells compared with unstimulated controls. COL V was not detected in cell culture medium despite addition of cross-linking inhibitor BAPN. COL III production decreased with increasing passage number and showed noticeable variations between individual cell lines. The difference in tenascin and elastin expression by stimulated cells compared with unstimulated controls was less pronounced but not dependent on cell line. Statistical analysis (Mann–Whitney test) showed a significant increase ($P < 0.05$) of proliferation of one of the tested cell lines after mechanical stimulation, which was not dependent on the passage number. A significant reduction of COL I production after mechanical stimulation was found in one of the tested cell lines and was significantly higher in passage numbers 12–14 than in passage numbers 4 and 5.
CONCLUSION: There is an interindividual variation in the reaction of HGF cell lines to mechanical stimulation *in vitro*, indicating heterogeneity of this cell type.
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84 SKELETAL TREATMENT RESPONSE TO STANDARDIZED ACTIVATION OF FUNCTIONAL APPLIANCES

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AIM: To investigate the sagittal skeletal treatment response to standardized activation and force application in functional appliance therapy.
SUBJECTS AND METHODS: Twenty-two consecutive young patients (13.2 ± 1.5 years) with a skeletal Class II malocclusion treated with a splinted Headgear Herbst appliance and step-by-step advancement of the mandible. Initially the mandible was advanced 2 mm, thereafter the mandible was advanced another 2 mm every 2 months. The headgear was used 10–12 hours/day and the applied force was 400–500 grams, and all patients' compliance was satisfactory. Lateral cephalograms obtained at the start and after 6 months of treatment were analysed according to Pancherz (1982). When the later cephalogram was obtained the patients had been under treatment for 6.0 (SD ± 0.12) months, and the mandible had been advanced the same amount, 3 × 2 mm, i.e. 6 mm in all patients.
RESULTS: The improvement of the jaw base relationship was 3.1 ± 1.4 mm ($P < 0.001$) and the range was 0.9 to 6.1 mm. The maxilla moved 0.0 ± 0.6 mm and the range was –2.1 to +1.5 mm. The mandible came forward 3.1 ± 1.5 mm ($P < 0.001$) and the range was 1.0 to 6.1 mm.
CONCLUSION: The individual response to standardized stimuli on the mandible, maxilla, and jaw base relationship over a given period of time varied from small to large changes.

85 VALIDITY OF DIGITAL PALPATION AS A DIAGNOSTIC TOOL: A METHODOLOGICAL STUDY

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AIM: To investigate whether the skin surface and the immediate underlying connective tissue have any influence on the nociceptive response to pressure stimulation over the masseter muscle.
SUBJECTS AND METHOD: Ten healthy volunteers and nine patients with chronic unilateral myalgia from the superficial masseter muscle were compared regarding pressure pain threshold (PPT). The variables were measured with an electronic pressure algometer before and after 60 minutes application of local surface anaesthesia (EMLA-cream). Bilateral equivalent sites on the superficial masseter muscle were examined. The most tender point (MTP) and its contralateral point (CLP) were examined in the patients and in the healthy individuals. A standardized point was used bilaterally. A reference point, not anaesthetized, on glabella, was used for comparison.
RESULTS: The PPT of the muscles increased significantly after skin surface anaesthesia in the healthy individuals, while there was no such response in the patients either on the MTP or on the CLP. There was no significant change in the PPT of the reference point either in the healthy individuals or patients.
CONCLUSIONS: The response to algometer pressure stimulation over the masseter muscle is due partly to a nociceptive response in the skin of healthy individuals, but not of patients with myalgia.

86 THE CEPHALOMETRIC RELATIONSHIP BETWEEN SKELETAL AND TRUE HINGE AXIS POINTS ON THE CONDYLE HEAD

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AIMS: To identify the true hinge axis points on the condylar head using a cephalogram and axiopath recorder after splint therapy.
MATERIALS AND METHODS: Eighty-one patients with temporomandibular dysfunction symptoms were divided into three groups: Skeletal I ($n = 17$), Skeletal II ($n = 49$) and Skeletal III ($n = 15$). The true hinge axis point data was obtained following splint therapy for 3–6 months.
RESULTS: Normally the true hinge axis position has been identified at 6.5 degrees to a reference line. Using the new method a stable position on the condylar head was established. The results of this investigation showed that Skeletal I and Skeletal II groups data were identified at approximately 6 degrees to this reference line, but the Skeletal III group were 4.1 degrees. *t*-test analysis revealed that the Skeletal I, II, and III groups were significant at the 99 per cent level.
CONCLUSIONS: The stable true hinge axis point positions were different between the Skeletal I and II groups and the Skeletal III group.

87 ONE-STEP MANDIBULAR ADVANCEMENT—FIXED VERSUS REMOVABLE FUNCTIONAL APPLIANCE TREATMENT

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AIM: To compare the skeletal changes and effects of one-step mandibular advancement with fixed and removable functional appliances.
SUBJECTS AND METHOD: Thirty-five young Caucasian males with moderate skeletal Class II malocclusions were observed for 12 months, during which 18 had conventional Herbst appliance treatment for 6 months followed by 6 months of retention with an Andresen activator (HAA) and 17 had treatment with a headgear activator (HGA) for the whole 12-month period. 'Normal' growth data for Class II malocclusions were available. Lateral cephalograms obtained at the start and after 12 months of treatment were analysed according to Pancherz (1982).
RESULTS: In both groups there was a significant effect on the jaw base relationship (HGA $P < 0.01$; HAA $P < 0.05$), and maxillary forward growth ($P < 0.05$), but only a small insignificant increase in mandibular forward growth (HGA +0.6 mm; HAA +0.4 mm). The increase in mandibular growth varied significantly more ($P < 0.001$) in the Herbst-Activator group compared with the headgear activator group. Lower face height was significantly affected only in the Herbst-Activator group ($P < 0.01$).
CONCLUSION: Treatment with both fixed and removable functional appliances with one-step mandibular advancement, on average, resulted in improvement of the jaw base relationship mainly due to restraint of maxillary forward growth, whereas mandibular growth seemed unaffected. However, it seems that mandibular growth varies following treatment with HAA. Lower face height was not affected by the HGA, but was increased with the HAA.

88 CEPHALOMETRIC CHANGES IN TWO DIFFERENT GROUPS OF CLASS II DIVISION 1 PATIENTS TREATED NON-EXTRACTION

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AIM: To evaluate the differential effect of the same type of biomechanics used in two different groups of Class II division 1 patients treated non-extraction by the same clinician.

SUBJECTS AND METHOD: Fifty-four patients, who presented a Class II molar and canine occlusion and an ANB angle greater than 4 degrees, were divided into two groups. The first group consisted of 32 individuals (12 males, 20 females, mean age 12.8 years), who were best described as high angle cases, with vertical mandibular growth potential, on the basis of an FMA angle greater than 28 degrees. The second group consisted of 22 individuals (10 males, 12 females, mean age 11.8 years), described as low angle cases, with horizontal mandibular growth potential, based on an FMA angle less than 22 degrees. Both groups were treated successfully to a Class I molar and canine occlusion and that was certainly the only bias in the hypothesis tested. Treatment biomechanics included the use of cervical headgear, Class II elastics, anterior bite plates, and fixed appliances, while no high pull headgear/posterior bite blocks or any other appliances to control vertical growth were used. The mean treatment time was 26 months. Skeletal and dental measurements were carried out regarding the vertical and horizontal changes during this active growth and treatment period on lateral cephalometric radiographs taken at the beginning and immediately after the end of treatment.
RESULTS: No statistically significant differences between the two groups were found for the combined vertical growth and treatment changes. The only statistically significant difference was noted in the high angle group, who presented a smaller ANB correction than the low angle group.
CONCLUSION: The use of vertical skeletal components of a lateral cephalometric radiograph as an absolute diagnostic tool can lead to mistreatment in Class II division 1 malocclusion patients.

89 A NEW UNALTERABLE ANGLE FOR MEASURING MANDIBULAR ROTATION

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AIM: To develop an accurate, unalterable, easy to reproduce measurement method that determines whether mandibular rotation takes place in adult Class III malocclusion patients.
MATERIALS AND METHODS: On dry skulls two mandibular and two maxillary points were selected and marked with wire. Xi was chosen as the ramus reference on the mandible since it was found after radiographic examination of the skulls that this point, constructed following Ricketts indications, was capable of change on subsequent radiographs. A new landmark, the Harfin–Porta (HP) angle, was determined on the midpoint of the entrance of the inferior dental nerve, as it was easy to reproduce. The second point was located on constructed Pm. A line connecting both points was traced. On the base of the nasal cavity two points were chosen (K1 and K2) and united by a line (K). No change was found in these points on several lateral radiographs of patients where growth had been concluded. Thirty pre- and post-treatment lateral radiographs of Class III malocclusion patients were traced following these points and the resulting angle formed by the mandibular and maxillary line was measured. The tracings were carried out by the same person and the radiographs taken using the same equipment and at the same distance.
RESULTS: The points selected were easy to reproduce on the pre- and post-treatment films. No changes were observed on the tracings of these points on the superimpositions of both films. The resulting angle was easy to trace and measure, showing accurately if mandibular rotation was an effect of Class III correction.
CONCLUSION: This new angle for measuring mandibular rotation is an accurate, easy to reproduce method for evaluating mandibular rotation as a side-effect of Class III correction.

90 TOOTH ERUPTION IN PREMATURELY BORN CHILDREN

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AIM: To examine the possible influence of pre-term birth on the clinical eruption of the permanent dentition.
SUBJECTS AND METHOD: Three hundred and twenty-eight prematurely born (<37 gestational weeks) white and black children and 1804 control children, who participated in the cross-sectional study of the Collaborative Perinatal Project (USA) in the 1960s and 1970s. Dental documents included dental casts taken at the age of 6–12 years. Pre-term and control children were placed in matched pairs by conceptional age, sex, and race for comparison of the four clinical stages of eruption of the permanent incisors and first molars. The hypothesis of binomial frequencies for discordant pairs was tested by McNemar's test.
RESULTS: There was significantly accelerated eruption of the first permanent molars and permanent incisors in prematurely born children compared with children born full-term. In the Afro-American children advanced eruption was found in the first molars and incisors and in the Caucasian children only in the incisors.
CONCLUSIONS: The findings focus on an early sensitive period in tooth development, when post-natal environmental factors, e.g. the early functional activity and the catch-up growth period in pre-term infants may influence the tooth eruption process.

91 THE INFLUENCE OF STEROID TREATMENT ON ORTHODONTICALLY INDUCED ROOT RESORPTION

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AIM: To evaluate whether corticosteroid treatment has an influence on the amount of root resorption seen during orthodontic tooth movement in rats.

MATERIAL AND METHODS: Sixty-four 6-month-old male Wistar rats, divided into three groups. Chronic group: corticosteroid treatment (daily subcutaneous injections of 8 mg/kg methylprednisolone) for 7 weeks and orthodontic treatment for 3 weeks. Acute group: corticosteroid treatment for 3 weeks and orthodontic treatment for 3 weeks. Control group: no pharmacological treatment, only orthodontic treatment for 3 weeks. A nickel-titanium (Sentalloy®) closed coil spring (25 g of force) was placed between the upper left first molar and the upper incisors. The contralateral side was kept untreated and used as the control according to the split mouth study design. Thin histological sections were obtained at the coronal and apical levels of the mesial root of the first molars. The percentage of surfaces with resorption was registered on the mesial and distal aspects of the root at ×200 magnification under light microscopy. The results were analysed using non-parametric statistics and significance was set at the 5 per cent level.
RESULTS: The rate of tooth movement increased in the chronic group compared with the control group. In general, root resorption was larger on the treated than on the control side, with the mesial side more affected than the distal. The acute group showed significantly more root resorption at the mesio-coronal treated side (26.3 per cent) compared with the chronic (14.3 per cent) and the control (7.5 per cent), while no significant difference was found between the last mentioned groups.
CONCLUSION: Increased amounts of root resorption can be expected in patients using short-term corticosteroid. Since asthma and other allergic symptoms are often treated in an acute manner and for short periods of time, the orthodontist needs to be particularly aware of the increased risk of root resorption in this group of patients.

92 CHANGE OF mRNA AND PROTEIN ISOFORMS IN THE MYOSIN HEAVY CHAIN OF MASSETER MUSCLES AFTER ORTHOGNATHIC SURGERY

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AIM: Orthognathic surgery leads to different muscle function after change of jaw position and occlusion. In an animal model it was shown that the adaptation consists of a shift between myosin heavy chain (MyHC) fibre type I, IIa, and II X/b. The aim of this study was to analyse the fibre shift in patients before and 6 months after orthognathic surgery.
SUBJECTS AND METHOD: Muscle samples were taken from the anterior and posterior parts of the right and left masseter muscles of 10 patients (five with a severe Class II malocclusion and five with a severe Class III malocclusion) before and 6 months after surgery. A highly sensitive method of the competitive polymerase chain reaction (cPCR) was established to study the mRNA isoform expression of MyHC in muscle fibres. The cPCR method identified the NM 000257 and AF111785 cDNA sequences as being specific to type I, IIa, and II X/b MyHC isoforms. Types I and II MyHC proteins were separated by SDS-polyacrylamide gel electrophoresis and by Western blot. The relative quantification was carried out by densitometric analysis of SDS-gel.
RESULTS: In patients with a Class II malocclusion the mRNA for type I MyHC decreased significantly ($P < 0.01$) 6 months after surgery. This reduction was more pronounced in the anterior (19 per cent) than in the posterior part (5 per cent). For type IIa and II X/b a slight increase in the anterior part was found following surgery (9 and 7 per cent, respectively). At the protein level the same shift of reduction for type I MyHC and increase of type IIa and type II X/b was noted.
CONCLUSION: cPCR and Western blot are suitable methods for detection of functional changes in masseter muscles after orthognathic surgery. The reduction of mRNA and proteins of type I MyHC is an indication of functional deficiency and instability in masseter muscle 6 months after surgery.

93 MACROSCOPIC AND RADIOGRAPHIC ANATOMY OF THE SKULL OF THE FERRET (*MUSTELA PUTORIUS FURO*)

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AIM: The use of ferrets in animal models for biomedical research is increasing because of the similarity of many anatomical, metabolic, and physiological features to those of humans. Other advantages are positive cost-effectiveness and possibly less ethical controversy when using these animals. However, the limited knowledge of the ferret's craniofacial anatomy and growth is restricting the full application of this animal in craniofacial research. The present study focuses on extending the knowledge of the normal macroscopic and radiographic anatomy of the skull of ferrets.
MATERIALS AND METHODS: The data were based on a sample of 100 (50 male, 50 female) adult ferrets. The skull anatomy was described macroscopically according to six standard views, i.e. dorsal, lateral, ventral, caudal, cranial, and midsagittal. The mandible was described separately. To enhance the macroscopic description, the roentgenographic characteristics of the ferret skull were demonstrated in lateral and dorsoventral projections. The skull length and width as well as the minimum frontal width were also measured, and skull indices were derived from these measurements. Sexual dimorphism was examined both morphologically and craniometrically.
RESULTS: Besides the common features of a carnivore skull, the ferret skull is relatively elongated and flat, with a short facial region. The skulls of adult male ferrets are about 17 per cent longer and 22 per cent wider than those of females. Significant sexual dimorphism also exists regarding the skull indices.
CONCLUSIONS: The presentation gives a detailed description of the normal anatomy of the ferret skull. This knowledge will provide the basis for further application of ferrets in animal models for craniofacial research.

94 PRIMARY TOOTH CROWN SIZE AND ASYMMETRY IN STRABISMUS

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AIM: To determine the primary tooth crown dimensions in strabismic children and the relationship between the type of strabismus and tooth crown size asymmetries.
MATERIAL AND METHODS: Dental casts in the mixed dentition of 2159 Collaborative Perinatal Study black and white children were measured, 123 of them strabismic at 1 year of age, age ranging from 6 to 12 years. Sex and race were considered in the comparisons. Directional and fluctuating asymmetries in antimeric teeth were explored in various types of strabismus having unilateral, bilateral, or alternating expression. ANOVA and *t*-square tests were used for size comparisons, and calculated asymmetries were explored by comparing the variances and Pearson correlations.
RESULTS: Strabismus was associated with a significant mesio-distal size increase of the primary maxillary canines in black boys and white girls. Black girls had a size reduction in their mandibular canine, but white boys were unaffected. Right side size dominance was found in the strabismic children in the lower second primary molar mesio-distal dimensions and in the children with alternating strabismus in their upper primary canine mesio-distal dimensions. Unilateral strabismus was associated with random fluctuating dental asymmetry in the primary second molar labio-lingual dimensions.
CONCLUSIONS: Tooth crown size left–right asymmetries can be associated with other symmetries in the facial complex and may help in determining the timing of developmental processes.

95 SECONDARY GENIOPLASTY: CEPHALOMETRIC ANALYSIS OF LONG-TERM OSSEOUS AND SOFT TISSUE CHANGES

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AIM: To demonstrate different indications and evaluate the immediate and long-term changes in hard and soft tissues of the chin after genioplasty.
SUBJECTS AND METHODS: Sixty-eight patients (43 females, 25 males) who underwent a genioplasty during the course of combined orthodontic–orthognathic surgical treatment between 1981 and 2001 were evaluated by means of cephalometric analysis and by clinical follow-up. Clinical examination and changes in the osseous and soft tissue chin from pre-operative, immediate post-operative, and long-term follow-up (mean 12 years). Radiographic and individual case analysis was carried out. The difference in the measurements was analysed statistically by paired *t*-test.
RESULTS: A reduction of height was performed in 59 patients, advancement in 57 subjects and a set-back in 11 cases. Post-operative complications were seen in 12 patients.
CONCLUSIONS: Relapse in the sagittal plane is not statistically significant and usually occurs within the first year.

96 NASAL OBSTRUCTION AND VARIATION OF UPPER AIRWAY SIZE

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AIM: Nasal obstruction is increasingly related to upper airway allergies rather than to turbinate hypertrophies, septum deviations, or other morphological traits. Therefore estimation of the functional nasal airway size, including the effect of the nasal mucosa, is important in orthodontic diagnostics. This study aimed to examine growth changes in the upper airways and respiratory function, with the hypothesis that upper airway size increases steadily with growth and shows sexual dimorphism.
SUBJECTS AND METHOD: One hundred and fifteen healthy adolescents were studied annually from 13 to 17 years of age. The participants did not have any acute upper airway infections or allergic rhinitis at the time of the examinations. The pressure–flow technique (Warren, 1984) was used to measure nasal airway size.
RESULTS: The mean value of the minimum nasal cross-sectional area, which determines upper airway resistance and thus nasal versus oral respiration, continued to increase in girls from 53 mm^2 (SD 14.2) at 13 years of age to 58 mm^2 (SD 22.6) in 17 year olds, with a temporary decrease at 15 years of age. In boys nasal size increased from 52 mm^2 (SD 15.8) to 68 mm^2 (SD 15.8). Boys tended to have larger mean values for nasal size except at 13 years of age, but the difference was not statistically significant until 16 years of age ($P = 0.03$ by ANOVA) with adult upper airway size.
CONCLUSIONS: Adult upper airway size was approximated earlier than expected, that is before other somatic growth ceased. The earlier and present results indicate cessation periods in the increase of the functional nasal passage size during prepubertal and pubertal growth. Reflecting the later strong growth spurt of adolescent boys and genetically derived factors, sexual dimorphism in upper airway size became clear at 16 years of age. Therefore it is suggested that in estimating nasal patency, age-specific guideline values should be used until 16 years of age, and gender-specific guidelines from 16 years on.

97 INFLUENCE OF TONGUE THRUST ON SPATIAL AND TEMPORAL DIMENSIONS ON SWALLOWING MOVEMENTS

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AIM: Malfunctions of the tongue are reported to be of major aetiological significance for the development of malocclusions and speech disorders. The aim of this study was to compare

the temporal and spatial dimensions of swallowing sequences to find objective parameters for the diagnosis of tongue thrust.
SUBJECTS AND METHODS: Thirty-one subjects aged 14.3–37.3 years with and without a diagnosis of tongue thrust were monitored during five repetitions of pure swallowing and swallowing water. The registration of tongue movement was carried out with an Articulograph AG 1009® (Carstens Medizinelektronik Company). The investigated area was the tip of the tongue and 1 and 2 cm further dorsal. The dimensions of geometric (distances) and time variables of tongue movement were analysed.
RESULTS: Statistical analysis showed more significant differences between both groups when swallowing water (47 per cent) compared with pure swallowing (20 per cent). Comparison of the variable distances showed more significant differences (47 per cent) compared with time variables (20 per cent). The movement between the palate separation point and the end of swallowing showed the highest number of significant differences. Depending on the variable, differences were found between the three regions. With all combinations of variables, overlapping interquartile ranges were always found between the groups.
CONCLUSION: Analysis of spatial and time intervals of swallowing movements by evaluation of electromagnetic articulography records offers the opportunity for objective diagnosis of tongue thrust. Therefore, depending on the area of the tongue, specific variables could be found which seemed to be the most suitable.

98 CHANGES IN MAXIMUM VOLUNTARY BITE FORCE DUE TO ORTHOGNATHIC SURGERY

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AIM: To determine the effect of orthognathic surgery on maximum voluntary bite force in patients who had undergone various orthognathic surgical procedures.
SUBJECTS AND METHOD: Twenty-eight patients (20 females, eight males). The mean age for females was 20.5 and for males 21 years. All subjects had various maxillomandibular discrepancies and were scheduled to undergo orthognathic surgery. Bite force measurements were carried out using a bite force transducer and for each patient the measurements were repeated three times on both sides of the occlusion. The highest value among these three measurements was taken for each side, and the higher of the right and left side values for every patient was accepted as the maximum bite force of that patient. The measurements were carried out just prior to surgery and 3, 6, and 12 months after surgery. The findings were statistically evaluated.
RESULTS: The mean pre-surgical bite force was 13.185 ± 8.563 kg for females and 21.087 ± 8.606 kg for males. The measurements obtained 3 months post-surgically showed a significant decrease in comparison with the pre-surgical values for both males and females. At the end of 6 months the bite force values reached pre-surgical levels and after 12 months exceeded the pre-surgical values for both groups.
CONCLUSION: Bite force exceeded pre-surgical values 12 months after surgery. Long-term studies are necessary in order to determine whether further improvement will take place.

99 CEPHALOMETRIC COMPARISON OF PHARYNGEAL CHANGES IN THE UPRIGHT AND SUPINE POSITIONS OF OBSTRUCTIVE SLEEP APNOEA PATIENTS

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AIM: To cephalometrically compare pharyngeal changes between upright and supine positions in patients with obstructive sleep apnoea (OSA).
SUBJECTS AND METHOD: Eighty-two OSA patients who had undergone cephalometric sleep apnoea analysis.
RESULTS: There was no significant change either in naso- or hypopharyngeal soft tissues between the two positions. In contrast, the distance between the soft palate and the posterior oropharyngeal wall was narrower in the supine than in the upright position. Both the shortest distance between the soft palate or the tip of the soft palate and the posterior pharyngeal wall were significantly diminished in the supine position. Whilst a slight thickening in the soft palate was detected in the supine position, the length of the soft palate did not change significantly. The form of the tongue changed significantly: it was shorter and thicker in the supine position.
CONCLUSIONS: OSA patients are prone to significant narrowing of the oropharyngeal, but not the naso- or hypopharyngeal, airway in the supine compared with the upright position. Thus, treatment of OSA subjects should be mainly targeted at preventing the oropharyngeal airway narrowing caused by the soft palate or the tongue, during nocturnal sleep.
This study was supported by a European Orthodontic Society Research Grant.

100 A RADIOGRAPHIC STUDY OF GROWTH OF THE MAXILLARY SINUS

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AIM: To investigate roentgenographically the relationship between growth of the maxillary sinus and Hellman's dental stage.
MATERIAL AND METHOD: One hundred dried skulls, 10 for each Hellman's dental stage, were studied. The parameters of the maxillary sinus were measured on computed tomographic images using a CT scanner (TCT-700S). The CT images were input into a CCD-TV camera for computer

analysis. In image analysis, pre-treatment of shadowing correction was followed by binary. The cross-section area of the left and right maxillary sinus was measured according to dental age. The measurement of cross-section was the nasal septum and vomer.
RESULT AND CONCLUSION: Marked growth of the cross-sectional area of the maxillary sinus was observed from stage IA to 2C, with a tendency to increase until stage 5A. The observed growth was symmetrical. Growth of the cross-section area of the maxillary sinus was observed to the growth of the neural type according to the growth curves of Harris and Scammon.

101 THE EFFECT OF AN ELECTROMAGNETIC FIELD ON TOOTH MOVEMENT

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AIM: To determine tooth movement acceleration during orthodontic treatment.
SUBJECTS AND METHODS: Ten Iranian dental students (mean age 23 years) who required orthodontic treatment. During bilateral upper canine retraction to relieve crowding, one side of the dental arch was stimulated with an electronic circuit embedded in a removable appliance in order to generate a pulsed electromagnetic field. Therefore one canine was retracted with a closed coil spring and a pulsed electromagnetic field while the canine on the contralateral side was retracted with a closed coil spring without a pulsed electromagnetic field. Retraction was continued until a normal canine position on both sides was achieved. Study models, radiographs, and photographs were taken before and after canine and tooth movement, and the experimental and control sides were compared with a paired *t*-test.
RESULTS: Tooth movement in the experimental side was 45 per cent greater than in the control side and this difference was significant ($P < 0.001$).
CONCLUSION: This finding that tooth movement on the experimental side was greater than on the control side suggests enhanced tooth movement due to the secondary effect of a magnetic field on bone remodelling.

102 A LOWER ANTERIOR HIGH PULL APPLIANCE FOR MODERATE OPEN BITE TREATMENT

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AIM: To determine the effectiveness of a lower anterior high pull (LAHP) appliance in correcting an anterior open bite in patients who reject orthognathic surgery since the use of fixed appliances results in a 'gummy smile'.
SUBJECTS AND METHOD: Ten patients (eight girls, two boys), with a mean age of 15.8 ± 2.5 years, all with a Class I malocclusion combined with a moderate skeletal open bite and a high lip line. Study models, radiographs, and photographs were obtained for all patients. Before treatment cephalometric landmarks (mandibular dental extrusion, etc.) were measured. After second premolar extractions the arches were banded and bonded using standard edgewise appliance. Space closure was performed by moving the posterior segment forwards. After space closure LAHP appliances were used for 8 hours a day in order to extrude the lower anterior teeth to an acceptable level. Following treatment, cephalometric landmarks were measured and compared with the pre-treatment landmarks by paired *t*-test.
RESULTS: The mandibular anterior teeth were extruded 1.75 ± 1.24 mm ($P < 0.01$) and the bite was closed 3.2 ± 2.3 mm ($P < 0.001$).
CONCLUSION: The LAHP appliance was successful in closing the bite in adults with a moderate open bite who reject orthognathic surgery.

103 ANGLE'S CLASSIFICATION AND CEPHALOMETRIC MEASUREMENTS OF FACIAL PROGNATHISM AND SAGITTAL APICAL BASE DIFFERENCE

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AIM: To evaluate the relationship between Angle's malocclusion classes and some cephalometric measurements of facial prognathism (angles SNA and SNB) and sagittal apical base difference (angle ANB, floating norms for ANB and Wits appraisal).
MATERIAL AND METHODS: Lateral cephalometric radiographs and dental plaster casts of 75 untreated orthodontic patients representing Angle's Class I (n = 33), Class II (n = 27), and Class III (n = 15) malocclusion classes. The patients were classified into Angle's classes on the basis of the sagittal occlusal relationship between the maxillary and mandibular first permanent molars, except in subjects with a history of ectopic eruption of the first permanent molar(s), premature loss of primary molar(s), or absence of premolar(s). In such cases the occlusal relationship between the maxillary and mandibular canines was considered. The patients were classified into a Class II category when a one- or both-sided distal relationship was present. Angles SNA, SNB, and NSL/UL and the Wits appraisal were measured on the radiographs. Two types of floating norms for ANB angle, FNj (Järvinen, 1986) and FNpw (Panagiotidis and Witt, 1976), and the corresponding diagnostic differences (ANB FN), were computed. For statistical analysis a regression analysis with dummy variables was used.
RESULTS: The relationship between Angle's classification and SNA was statistically insignificant (R^2 = 0.004). The corresponding coefficients for the determination of SNB, ANB, Wits, and the floating norm differences between Fnj and FNpw were 0.254 (P = 3.9E–6), 0.567 (P = 5.5E–15), 0.756 (P = 0), 0.706 (P = 0), and 0.730 (P = 0), respectively.
CONCLUSIONS: In individual diagnostic use, the angles SNA and ANB should be handled with caution.

104 SYSTEMIC DEPLETION AND SUPPLEMENTATION OF ALIMENTARY ZINC AND ITS EFFECT ON BONE HEALING IN RAT CALVARIA

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AIM: To assess the skeletal effects of alimentary zinc depletion and supplementation in the healing of surgically created rat calvarial defects filled with different osteopromotive substances.
MATERIALS AND METHOD: Sixty male Wistar adult rats were divided into three equal groups and fed different zinc diets consisting of 2, 47, 60 mg zinc/kg, simulating hypo, normal, and hyper zinc diets, respectively. Bilateral critical size trephined defects were prepared in the parietal bones of each animal and then filled with either demineralized bone matrix, autogenous bone, or left unfilled serving as controls. Within each of the three groups the left and right defects were filled in such a manner to allow comparison with each other. The repaired defects were evaluated biomechanically by a three-point bending test after 3 months of healing.
RESULTS: Biomechanical tests revealed a significant zinc-induced increase in bone strength at all sites investigated. It showed that zinc influenced bone in a dose-dependent manner except for the unfilled controls.
CONCLUSION: Alimentary zinc supplementation in adult rats induces an increase in bone strength when evaluated by means of biomechanical testing.

105 GROWTH CHANGES IN RESPIRATORY FUNCTION IN ADOLESCENTS

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AIM: If the upper airway is obstructed and nasal resistance is high, the respiratory pattern changes from nasal to oral breathing with its deleterious effects on general and dental health. Earlier results (Crouse *et al*., 2000) demonstrated that nasal resistance did not decrease steadily with growth but showed prepubertal cessation. The purpose of this research was to longitudinally examine respiratory changes during late adolescence and to determine at what age nasal resistance reaches adult level.
SUBJECTS AND METHODS: One hundred and fifteen adolescents followed from 13 to 17 years of age (1997–2001) to monitor respiratory function. The pressure–flow technique (Warren, 1984) was used to measure nasal resistance.
RESULTS: Inspiratory nasal resistance decreased in boys from a median of 2.2 $cmH_2O/l/s$ (quartile range 1.6, 3.4) at 13 years to 1.6 $cmH_2O/l/s$ (1.2, 1.9) at 17 years of age, while it remained at 1.9 $cmH_2O/l/s$ (1.3, 2.6) in girls. However, there was a temporary mild increase ($P = 0.07$ Wilcoxon test) at 15–16 years of age. Although the median values of resistance were systematically lower for girls compared with boys until the age of 16 years, the difference was statistically significant only for the youngest age group ($P < 0.05$, Mann–Whitney test).
CONCLUSIONS: Upper airway resistance is affected by differences in timing in growth between genders. It already approximates the adult level of <2 $cmH_2O/l/s$ at 13 years of age in girls and at 14 years in boys but does not stabilize at that level until 17 years of age. When nasal resistance is used to assess how well an individual can breathe entirely through the nose, or whether oral breathing and open mouth posture are a more physiological option, age- and gender-specific guideline values need to be applied.

106 VIDEOFLUOROSCOPY OF THE SWALLOWING ORAL PHASE IN 8- TO 12-YEAR-OLD CHILDREN WITH DENTAL MALOCCLUSION

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AIM: To describe the swallowing oral phase in individuals with dental malocclusion and to generate data that would contribute to the rehabilitation of these patients.
SUBJECTS AND METHOD: Evaluation of the swallow system through videofluoroscopy of 34 children of both genders, aged 8–12 years, with Angle Class II and III dental malocclusions. Thirteen children matched for age and gender with a normal dental occlusion formed the control group.
RESULTS: The swallow mode (oral phase) was different between individuals with normal occlusion and malocclusion. The individuals with normal dental occlusion presented 'tipper type' swallowing, while those with Angle II and III dental malocclusions did not present a swallowing pattern, independently of the amount ingested. Different modes of swallowing occurred in those individuals who were classified as inconsistent adaptations (Type 1 adapted tipper, Type 2 in two rounds, Type 3 stretched, Type 4 adapted dipper and inconsistent irregular). The swallowing of smaller amounts facilitated the occurrence of consistent adaptations Types 1 and 2. The swallowing of larger amounts facilitated the occurrence of consistent adaptations Types 3 and 4, for dental malocclusion type Class II and III. The swallowing appeared efficient in the oral phase of individuals with dental malocclusion, even though adaptations were identified.
CONCLUSIONS: The results concerning the amount ingested, the absence of a single pattern, and the efficiency of adapted swallowing demonstrate a need to reconsider myofunctional treatment for patients with malocclusion. Further research in this area would contribute positively to the rehabilitation of these patients.

107 CEPHALOMETRIC CHANGES FOLLOWING JASPER–JUMPER TREATMENT OF CLASS II DIVISION 1 MALOCCLUSIONS

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AIM: To evaluate the dentoskeletal and soft tissue profile changes of patients with Class II division 1 malocclusions treated with the Jasper–Jumper appliance.
MATERIALS AND METHOD: Lateral cephalometric radiographs of 18 children with a Class II division 1 malocclusion in the permanent dentition treated with the Jasper–Jumper appliance. The radiographs were taken before insertion and immediately after appliance removal. The duration of this part of treatment was 8.9 months. Thirty-two cephalometric landmarks were used in order to assess 61 variables of sagittal and vertical skeletal and soft tissue profile relationships, soft tissue thickness, and lip morphology. Statistical analysis was performed by means of paired *t*-tests (level of significance: $P < 0.05$). The error of the method was assessed by means of double tracing and digitizing of 18 randomly selected cephalometric radiographs according to Dahlberg's formula.
RESULTS: Dentoskeletal changes: there was a reduction of SNA angle, overjet, and overbite, an increase of anterior face height, a palatal inclination of the upper incisors, and a labial inclination of the lower incisors. For the soft tissue profile there was a significant increase of the lower face height and of the upper and lower lip width, as well as a decrease of lower lip convexity.
CONCLUSIONS: Jasper–Jumper appliance treatment of Class II division 1 malocclusions was associated with some desirable profile changes, especially in the dentoalveolar region.

108 EFFECT OF EXPERIMENTAL MANDIBULAR DISTRACTION ON THE TEMPOROMANDIBULAR JOINT SURFACE

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AIM: To clarify how unilateral mandibular ramus distraction osteogenesis affects the temporomandibular joint (TMJ) surface both in operated and contralateral sides directly following distraction and after long-term follow-up.
MATERIAL AND METHOD: Fourteen growing sheep in whom distraction was performed with an extra-oral appliance, starting 5 days post-operatively. The distraction period varied from 4 to 16 days with daily distraction from 0.5 to 1 mm. The follow-up period was from 0 to 52 weeks. The condylar heads were harvested after sacrifice, fixed in glutaraldehyde, dehydrated in serial alcohol, and gold plated. The analysis was carried out by scanning electron microscopy and photographed at ×20 and ×50 magnification. The joint surfaces were analysed from photographs and graded into four levels as follows: 0 = no change from normal, 1 = slight changes, 2 = severe changes, 3 = bone surface visible.
RESULTS: Most changes were mild and occurred soon after the distraction period. There were, however, also severe changes. The changes were seen both in the operated and contralateral sides. After long-term follow-up most of the joints appeared normal with one exception.
CONCLUSION: Even though the observed changes seem to be mostly mild, the TMJ should also be considered when planning distraction osteogenesis.

109 EFFECTS OF HEADGEAR, INTRA-ORAL ELASTIC WEAR, AND PATIENT COMPLIANCE DURING ORTHODONTIC TREATMENT

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AIM: To study the effects of headgear, intra-oral elastic wear and patient compliance during orthodontic treatment.
MATERIAL AND METHODS: Factors related to compliance with the wearing of headgear and intra-oral elastic were evaluated in a sample of 110 orthodontic patients (54 boys, 56 girls). The data were gathered by means of a questionnaire that evaluated the patients' opinions and approaches to orthodontic treatment, headgear, and intra-oral elastic wear. In general the questions involved two different parts: firstly, negative motives (pain, inconvenience, and dysfunction), and secondly, positive motives (general health awareness, specific dental knowledge, and private-social values). The data were evaluated using descriptive statistics. A Chi-square test was used to assess the differences between the positive and negative answers of the girls and boys.
RESULTS AND CONCLUSIONS: The patients had no complaints about pain, inconvenience, or dysfunction during fixed appliance therapy. However, in half of the patients, the complaints increased while using headgear and wires that applied active force. Pain was the major reason for not wearing headgear and intra-oral elastics both in girls and boys, with girls complaining more often than boys. In spite of the problems, it was observed that internally motivated patients used the headgear and intra-oral elastic. Throughout orthodontic treatment, self-help/relevance and education are the most important things for patient compliance.

110 CHANGES IN CRANIAL BASE ANGLE OF UNTREATED SKELETAL CLASS II DIVISION 1 SUBJECTS DURING THE CRANIOFACIAL GROWTH PERIOD—A CROSS-SECTIONAL STUDY

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AIM: To investigate changes in the cranial base angle of untreated skeletal Class II division 1 subjects during the craniofacial growth period.

SUBJECTS AND METHOD: The Class II subjects were selected on the basis of molar and canine relationship (both full Class II), the amount of overjet (>6 mm), and the amount of ANB angle (>6°). A total of 330 cephalometric radiographs (102 boys, 228 girls) were used. Based on their chronological age the sample was divided into eight groups. Group A (6–6.99 years, 16 individuals), group B (7–7.99 years, 29 individuals), group C (8–8.99 years, 56 individuals), group D (9–9.9 years, 60 individuals), group E (10–10.99 years, 63 individuals), group F (11–11.99 years, 38 individuals), group G (12–12.99 years, 39 individuals), and group H (older than 13 years, 29 individuals). The cephalometric radiographs were scanned and digitized on screen using commercial software (Viewbox). Three common cranial base angles (BaSNa, BaSse, arSNa) were used to evaluate any change. Data were analysed using analysis of variance (ANOVA) to assess significant differences between age groups and subgroups. Significant differences between groups were further analysed using multiple comparison tests such as the Bonferroni test. The level of significance used was $P < 0.05$.
RESULTS: The findings support the view that although there is a trend for cranial base angle to increase with age, this increase is not statistically significant.
CONCLUSIONS: The cranial base angle after 6 years of age stays almost stable and, therefore, treatment protocols regarding skeletal Class II cases should be based on maxillo-mandibular structural differences.

111 AGE AS A FACTOR OF TREATMENT SUCCESS IN CLASS II FUNCTIONAL APPLIANCE THERAPY

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AIM: Treatment of skeletal Class II subjects is believed to be more effective at early ages. However, a review of the literature shows successfully treated cases even in patients up to 15 years. The purpose of this study was to examine the effect of activator treatment on skeletal Class II malocclusions in different age groups.
MATERIAL AND METHOD: Pre- and post-treatment cephalometric radiographs of 170 skeletal Class II subjects (95 girls, 75 boys). The treatment duration varied between 14 and 20 months. The patients were divided into seven groups according to age at the beginning of treatment. Group A (age 6–7.99 years, nine patients), B (age 8–8.99 years, 43 patients), group C (9–9.99 years, 38 patients), group D (10–10.99 years, 27 patients), group E (11–11.99 years, 31 patients), group F (12–12.99 years, 13 patients), and group G (13 years and older, nine patients). All radiographs were digitized on-screen and corrected for magnification using commercial software (Viewbox). Five angular (BaSN, SNA, SNB, ANB, MP–SN) and five linear (Wits, ANS–PNS, Ar–Gn, overjet, overbite) variables were measured. Data were analysed using analysis of variance (ANOVA) to assess differences between the age groups. Significant differences between groups were further analysed using multiple comparison Bonferroni tests. The level of significance was set to 0.05. Thirty cases were randomly selected and redigitized for method reliability testing.
RESULTS: No significant differences in any of the measured variables between the seven groups were detected.
CONCLUSIONS: Age does not seem to be a decisive factor in functional treatment of skeletal Class II subjects. Positive results can be obtained, even if treatment is not initiated early.

112 EVALUATION OF HARD AND SOFT TISSUE CHANGES IN INDIVIDUALS WITH ANGLE CLASS I MALOCCLUSIONS TREATED WITH FOUR PREMOLAR EXTRACTIONS

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AIM: To evaluate the hard and soft tissue profile changes in Angle Class I subjects with arch length discrepancy treated with four first premolar extractions and the edgewise technique.
MATERIALS AND METHOD: Forty-four pre- and post-treatment lateral cephalometric radiographs, obtained from 22 patients (18 girls, four boys). In order to determine treatment effects, 25 dental-skeletal and 15 soft tissue measurements were measured on the radiographs. Statistical analysis of the data was evaluated with paired *t*-tests for paired groups using SPSS/PC Version 10.0.
RESULTS: Skeletal changes: SNA and ANB angles reduced, convexity angle increased, upper and lower total anterior face heights increased due to extraction therapy. Dental changes: overjet and Holdaway difference reduced due to upper and lower incisor retrusion. Soft tissue changes: the upper and lower lip retruded and were positioned behind Steiner's aesthetic line due to the extractions, while nasion and pronasale developed.
CONCLUSION: Hard and soft tissue profiles became coincident.

113 A NEW METHOD FOR UNILATERAL MOLAR DISTALIZATION WITHOUT ANCHORAGE LOSS

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AIM: To investigate the side-effects of unilateral headgear and some intra-oral distalization mechanics that would: (1) achieve bodily molar distalization; (2) eliminate anchorage loss on the first premolars during distalization; (3) minimize patient co-operation (no headgear, elastics, or removable appliances).
SUBJECTS AND METHOD: In a preliminary investigation, four males and seven females were selected for unilateral

molar distalization. The mean age of the group was 15.7 years. Dentally, all patients presented a unilateral Class II molar relationship and were in the permanent dentition with second molars erupted and a well-aligned lower dental arch. For maxillary molar distalization, the Keles Slider was modified to eliminate anchorage loss on the first premolars. The appliance consisted of two premolar and two molar bands, and the anchorage unit comprised the buccal teeth on the Class I side instead of a Nance button on the palate. This modification diverted the reciprocal mesial force of the coil spring to a moment. This newly introduced force-moment system prevented mesial migration of the first premolars.
RESULTS: Lateral cephalogram evaluation showed that the Class II molars distalized bodily 4.1 mm ($P < 0.001$) on average. There was no anchorage loss at the first premolars and incisors. Slight incisor proclination was observed, but this was not statistically significant.
CONCLUSION: Unlike other intra-oral molar distalization mechanics, this newly developed device achieves bodily distal movement of molars without anchorage loss. In addition to distalizing the molars, the appliance has been used to stabilize and hold the molars in a Class I relationship and then distalize the premolars and canines into Class I without anchorage loss.

114 EVALUATION OF THE COMPATIBILITY OF HOWES' ORTHODONTIC CAST ANALYSIS IN A TURKISH POPULATION

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AIM: To evaluate the transverse arch dimensions and compatibility of Howes' orthodontic cast analysis in a Turkish population.
MATERIALS AND METHOD: Dental casts and lateral cephalograms of 55 patients (25 males, 30 females) aged between 18 and 26 years with a Class I occlusal relationship. No subject had a history of systemic disease or had undergone prior orthodontic treatment. Original Howes' orthodontic cast analysis was applied to the study casts and cephalograms. Four millimetric and three proportional parameters were used for this analysis. The widths of the teeth, the left and right first premolar coronal arch, and the transversal basal arch width were measured on the upper and lower dental casts, and the maxillary and mandibular basal arch lengths on the cephalograms. The ratio of first premolar coronal arch width, basal arch width, and basal arch length to tooth width were measured. Statistical analysis of the data was evaluated with the Student's *t*-test.
RESULTS: No statistically significant differences were recorded for the first premolar coronal and basal arch widths in either arch. Maxillary and mandibular tooth material was significantly greater than Howes' analysis standards, $P < 0.05$, $P < 0.001$, respectively. The ratio of basal arch width to tooth material in the maxillary arch was significantly lower than Howes' standards ($P < 0.05$), whereas the ratio of basal arch length to tooth material in the maxillary arch was significantly higher ($P < 0.001$). Maxillary basal arch length and the ratio of this parameter to tooth material were significantly higher than Howes' standards ($P < 0.001$). Mandibular basal arch length and the ratio of this parameter to tooth material were significantly lower than Howes' standards, $P < 0.01$, $P < 0.001$, respectively.
CONCLUSION: Howes' orthodontic cast analysis was found applicable in this Turkish population, except for tooth width and basal arch lengths.

115 THE EFFECT OF HEADGEAR ON THE UPPER SECOND MOLARS

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AIM: To investigate the effect of headgear use on the eruption of the upper second molars.
SUBJECTS AND METHOD: Sixty male and 60 female skeletal Class II patients treated with headgear were divided into good and poor eruption groups according to the degree and position of the upper second molar after treatment. Lateral cephalometric radiographs and dental casts were obtained before and after treatment, and all cephalometric measurements were statistically analysed.
RESULTS: The eruption angle (HRL/M6–M7) and the steepness of the palatal plane in the ectopic eruption group were greater than those of the normal eruption group before and also after treatment. There was no significant difference pre- and post-treatment in the horizontal measurements of the upper first molar (VRL–M6, PTV–M6) in either group.
CONCLUSIONS: Initial eruption angle (HRL/M6–M7) may be a possible indicator of the prediction of upper second molar eruption after the use of headgear.

116 ECTOPIC ERUPTION OF THE MAXILLARY SECOND MOLAR

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AIM: To study the prevalence of ectopic eruption and the relationship with gender, skeletal malocclusion, vertical profile pattern, and maxillary second molar tooth size.
SUBJECTS AND METHOD: Four hundred and twenty-four males and females treated between March 1988 and February 2001 who showed full eruption of the maxillary second molar were selected with regard to the ectopic eruption of the maxillary second molar. Lateral cephalometric radiographs and dental casts were obtained.
RESULTS: (1) A total of 19.1 per cent of the patients experienced ectopic eruption of the maxillary second molar. (2) Of these, 25.9 per cent were male and 74.1 per cent female. (3) A skeletal Class I malocclusion was present in 32.1 per cent, 33.3 per cent were skeletal Class II, and 34.6 per cent skeletal Class III. (4) In 45.7 per cent there was a

hyperdivergent profile, 45.7 per cent had a normal profile, and 8.6 per cent a hypodivergent profile. (5) The size of the ectopically erupted maxillary second molar was larger than that of the normally erupted maxillary second molar.
CONCLUSIONS: Approximately 20 per cent of the patients examined with a fully erupted maxillary second molar experienced ectopic eruption of the maxillary second molar.

117 CHANGING OCCLUSAL PATTERNS AND THE INDICATOR LINE IN EXTRACTION AND NON-EXTRACTION TREATMENT

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AIM: To investigate changes in the values of the occlusal pattern and the length of the Indicator Line (distance from the lowest point on either upper central incisor to the tip of the nose) in extraction and non-extraction cases before and after orthodontic treatment.
SUBJECTS AND METHODS: Twenty-two extraction and 22 non-extraction Japanese with a Class II malocclusion. The occlusal patterns were measured using the Dental Prescale-Occluser System for occlusal contact areas (mm^2 = 'area'), an average occlusal pressure on occlusal contacts (MPa = 'Ave'), and all of the occlusal force (N, abbreviated as 'force'). This study utilized the Indicator Line and occlusal pattern to compare extraction and non-extraction treatment.
RESULTS: The average difference values in extraction cases before and after treatment were area 1.35 mm^2, ave. –0.96 MPa, and force 56.46 N, compared with the average difference values of area 2.60 mm^2, ave. –1.94 MPa, and force 141.68 N in the non-extraction group. The average difference from the ideal Indicator Line before and after treatment was –0.45 mm in the extraction group, with an average difference of –0.23 mm in the non-extraction group.
CONCLUSIONS: Non-extraction treatment might result in increased occlusal stability compared with extraction treatment.

118 PULPAL BLOOD FLOW AND REGENERATED BONE DENSITY CHANGES AFTER ALVEOLAR DISTRACTION OSTEOGENESIS

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AIM: To investigate changes in pulpal blood flow and regenerated bone density after alveolar distraction osteogenesis.
MATERIALS AND METHOD: An adult beagle dog was used in this experiment. After extraction of the left maxillary incisors, alveolar bone at the same site was removed to create a bone defect (10 mm length). One month later, the maxillary first and second premolars on both sides were extracted. A distraction osteotomy was performed at the mesial site of the maxillary third premolar. The intra-oral distraction device was set with a bicortical screw in the osteotomy region. After a three-day latency period, transportation of the segment into the bone defect area was carried out at a rate of 2 mm per day for 5 days. Canine pulpal blood flow was recorded with laser Doppler flowmetry. After 95 days consolidation, the animal was sacrificed and prepared for analysis of bone density and newly created bone area using peripheral quantitative computerized tomography.
RESULTS: Canine pulpal blood flow on the distracted site decreased remarkably with the activation of the screw but gradually recovered to the pre-osteotomy level. Bone density and the newly created bone area showed a clearly lower level compared with the control site.
CONCLUSION: The recovery process of pulpal blood flow after distraction proceeds gradually and reaches the original level by 100 days. Newly induced bone density with 2 mm/day distraction is not unlike that in the control area.

119 OCCLUSAL DISHARMONIES IN THE PRIMARY DENTITIONS

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AIM: To compare the relationship between occlusal disharmonies in the primary dentition in children with related and unrelated fluorosis.
SUBJECTS AND METHOD: One hundred and seventy-five children (86 girls, 89 boys) 3–6 years of age living in Isparta, a fluoridated area, and 235 (112 girls, 123 boys) children residing in Erzurum, a non-fluoridated area. Statistical analysis was carried out using SPSS 7.5 for Windows.
RESULTS: The frequency of a deep overbite, excessive overjet, anterior crossbite, anterior open bite, posterior crossbite, and anterior crowding was 14.9, 9.14, 4.6, 3.4, 1.71, and 1.14 per cent, respectively, in children with related fluorosis. For children in a non-fluoridated area the frequencies were 8.94, 8.51, 2.12, 8.51, 1.70, and 1.28 per cent, respectively.

120 TIME-RELATED BOND STRENGTH OF A SELF-ETCHING PRIMER/ADHESIVE

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AIM: To determine the bond strength of a light-cured composite resin with a self-etching primer when used to bond mesh-backed brackets to bovine teeth.
MATERIALS AND METHODS: One hundred and twenty bovine mandibular incisors were used. Progressively finer polishing of the enamel surface was performed with 120–2400 grit waterproof abrasive paper. A light-cured bis-GMA-based composite resin (Transbond XT, 3M Unitek, USA) and two sealants were used: a self-etching primer (Transbond plus) and a conventional primer (Transbond XT

primer). All bonding mediums were handled according to the manufacturers' instructions. Each bracket was exposed for 20 seconds to a light unit (New Light VL-II, GC Corp., Japan) at the incisal and gingival margins. After 0 and 3 minutes and 24 hours, and thermal cycling 2000 times, bond testing was performed. A universal testing machine (Shimadzu Co. Ltd, Japan) was used to measure shear bond strength.
RESULTS: Bond strengths of both primers increased with time. The mean bond strengths and SD of the self-etching primer were: 0 minutes = 20.7 (5.9) MPa, 3 minutes = 22.3 (6.1) MPa, 24 hours = 32.0 (11.8) MPa, thermal cycling = 35.1 (7.1) MPa. The mean bond strengths and SD of the conventional primer were: 0 minutes = 22.3 (6.6) MPa, 3 minutes = 23.7 (5.5) MPa, 24 hours = 35.8 (10.7) MPa, thermal cycling = 35.4 (8.3) MPa. ANOVA showed no significant difference in bond strength between the self-etching and conventional primer. No significant difference was seen in bond strength between 24 hours and thermal cycling.
CONCLUSION: The self-etching primer tested has a retentive strength similar to a conventional primer. A self-etching primer/adhesive appears to be adequate for clinical use.

121 RELIABILITY OF FUNCTIONALLY ORIENTATED MEASUREMENT OF MIMIC MUSCULATURE

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AIM: To introduce a critical view of functionally orientated measurements in Face-Former® training and to determine the reliability of measuring the activity of orofacial musculature using the Myo-Bar-Meter®.
MATERIAL AND METHODS: The Face-Former® is used clinically for myofunctional training and to measure the functional status of orofacial musculature. A new measuring device has been developed to test the effect of myofunctional exercises. Using the Myo-Bar-Meter® (ISST, Unna), lip strength and activity of the orofacial musculature was measured clinically in 48 subjects. Twenty-four subjects exercised using Face-Former® training three times a week, whilst the other 24 subjects who did not exercise formed the control group. Myo-Bar-Meter® measurements were carried out at the beginning of training, every 2 weeks, and at the end of the training period. All results were measured in millibars, documented, and calculated using the statistical software package SPSS (version 10.5.2).
RESULTS: The values of the control and training groups showed three maxima of pressure calculation: 20, 45, and 70 mbar. The results of measuring lip pressure can be reproduced well. If only one investigator is involved the kappa-index is very high ($\kappa = 0.81$). If three investigators undertake the measurements the kappa-index is also high ($\kappa = 0.76$). Positive effects in the orofacial musculature are common. The functional orientated results of exercises using Face-Former® training are statistically evident compared with the control group ($P < 0.001$).
CONCLUSIONS: Lip strength measurements during Face-Former® training using the Myo-Bar-Meter® can be reproduced at a high level. First results on myofunctional training of the orofacial musculature (training group, $n = 24$; control group, $n = 24$) demonstrate the effectiveness of the Face-Former®. The method introduced can be used simply in daily life and is a low-cost treatment of myofunctional disturbances of the orofacial musculature.

122 A FOLLOW-UP STUDY OF MAGNETIC RESONANCE IMAGING AND CLINICAL TEMPOROMANDIBULAR JOINT FINDINGS IN CHILDREN WITH JUVENILE IDIOPATHIC ARTHRITIS

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AIM: To investigate whether a correlation exists between clinical and magnetic resonance imaging (MRI) findings of the temporomandibular joint (TMJ) in children with juvenile idiopathic arthritis (JIA). Furthermore, development of the MRI over time was followed so that morphological changes could be described.
SUBJECTS AND METHODS: Fifteen children with newly diagnosed JIA were examined with MRI four times with a 6-month interval. At the same time a clinical examination of the TMJ was performed. The MRI examination was carried out using a 1.0 T Signa Horizon magnet with T1-weighted images pre- and post-contrast injection with Gd-DTPA. The evaluated parameters were: enhancement, condylar morphology, pannus, and intra-articular fluid. The MRI findings were scored 0 = no abnormalities, 1 = some/slight pathology, and 2 = severe pathology for each joint, giving a maximum total score of 16 per patient. The clinical findings were scored according to a modified version of Helkimo's index. The total MRI score for the individual patient was correlated with the total score for the clinical findings in each patient per time.
RESULTS: The patients with a high clinical score also showed a high total MRI score. No statistical correlation between patients with a low or moderate overall clinical finding score and the corresponding total MRI score could be found. MRI over time showed that the parameters evaluated, except for erosions, fluctuated. Erosions increased over time.
CONCLUSION: TMJ involvement in JIA should be looked upon as a chronic disease with active inflammatory periods. Contrast-enhanced MRI can indicate when the inflammatory process is active and thus when treatment has to begin in order to avoid growth disturbances. Contrast-enhanced MRI of the TMJ should be performed in patients with few clinical findings.

123 PREVALENCE OF TOOTH SIZE DISCREPANCY AMONG DIFFERENT MALOCCLUSION GROUPS

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AIM: To estimate the eventual prevalence of tooth size discrepancy related to skeletal malocclusion observed in Campania people. The aims were to estimate by linear regression analysis Bolton's posterior, anterior, and total ratios relationship.
MATERIAL AND METHODS: The mesio-distal diameters of the teeth on 94 pre-treatment models of orthodontically treated patients were measured using digital electronic callipers (calibrated to 1/100 mm) and Bolton's indices were calculated. Based on Steiner's cephalometric analysis, the sample was grouped into the three skeletal malocclusion Classes.
RESULTS: A significant linear relationship (R^2 = 0.99, Sig = 0.0000) using multiple regression analysis was verified on Bolton's posterior, anterior, and total indices. The discriminant multivariate analysis, based on stepwise Wilk's Lambda, identified five variables capable of classifying the sample into four distinct groups, of which 88.6 per cent were correctly classified.
CONCLUSIONS: As no relationship was found between the four groups calculated by discriminant analysis and the three skeletal Classes variously included in the four groups, it can be concluded that no evident prevalence exists between tooth size discrepancy and the three skeletal malocclusions.

124 THE TWIN BLOCK IN THE TREATMENT OF OBSTRUCTIVE SLEEP APNOEA

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AIM: To test the effectiveness of the Twin Block in relation to the Herbst mandibular advancement splint (MAS) in the treatment of patients previously diagnosed with obstructive sleep apnoea (OSA).
SUBJECTS AND METHODS: Sixteen patients were involved in this prospective, randomized, crossover study. Each patient was fitted with both a Twin Block and a Herbst MAS in a random order. These were worn and, where appropriate, advanced until the patient was subjectively happy with the effects of the appliance. Questionnaires and visual analogue scales (VAS) were used to assess differences in snoring, excessive daytime sleepiness (EDS), quality of life, side-effects, and patient preference. Overnight domiciliary sleep recordings were used in order to measure sleep quality by means of an apnoea–hypopnoea index score, snoring frequency (snores/hour), and arterial blood oxygen saturation. These subjective and objective measurements were carried out at baseline and after fitting each appliance. A 2-week wash-out period was implemented before the fitting of the second appliance.
RESULTS: No significant difference in the treatment performance of the Twin Block and Herbst MAS was found in terms of AHI (P = 0.706), snoring (P = 0.485), arterial blood oxygen saturation (P = 0.969), quality of life, and side-effects (P = 0.496). The Herbst MAS proved to be significantly better at treating EDS when measured using a VAS sleepiness scale (P = 0.039). However, there was no significant difference between the two appliances when EDS was measured using the Epworth Sleepiness Scale (P = 0.411). Side-effects with both appliances were minor and improved significantly (Herbst P = 0.022; Twin Block P = 0.010) in the long-term. The Herbst MAS proved to be the more popular appliance amongst the patients.
CONCLUSIONS: (1) The Twin Block is a viable alternative to the Herbst MAS in the treatment of patients with OSA. (2) For the treatment of EDS the Herbst MAS may be more effective. (3) The Twin Block would, however, benefit from any changes in design that would hold the mandible more securely in the protrusive position.

125 DIAGNOSTIC EQUIPMENT FOR STUDYING THE MORPHOLOGY OF THE HUMAN FACE

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AIM: A number of contemporary cephalometric analyses are based upon studies of facial hard tissues. Another important aspect of treatment planning is the study of soft tissues for obtaining a harmonious profile. The aims of this investigation were to study the facial soft tissues relative to the out of facial vertical plane (Vp) using diagnostic equipment.
SUBJECTS AND METHOD: Fifty children, aged 7–12 years, with physiological occlusion. Persin has suggested the use of Vp, which is perpendicular to Frankfort horizontal through the stable point, and placed on the frame of the standard facial arc. The facial arc (FAG, France) was used. The diagnostic equipment was placed on the patient's face according to Frankfort horizontal, and the distances from Vp to the anthropometric facial soft tissue points were measured using a specially designed measuring tool. The following distances were studied: Vp–nasion (n), Vp–pronasale (pn), Vp–subnasion (sn), Vp–stomion (st), Vp–supramentale (sm), and Vp–pogonion (Pog).
RESULTS: The average data for the parameters studied were: Vp–n = 68.6 ± 1.2 mm; Vp–pn = 53.6 ± 0.8 mm; Vp–sn = 67.1 ± 0.8 mm; Vp–st = 69.3 ± 1.0 mm; Vp–sm = 77.7 ± 1.0 mm; Vp–Pog = 81.3 ± 1.3 mm.
CONCLUSION: The adequacy of the diagnostic equipment was proven.

126 OESTROGEN-ASSOCIATED PROTEIN, HSP27, EXPRESSION IN HUMAN TEMPOROMANDIBULAR DISCS CORRELATES TO INTERNAL DERANGEMENT BUT NOT TO GENDER

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AIM: Heat shock proteins (HSPs) are believed to represent a mechanism of response to cellular stresses that protect

intracellular proteins from damaging events. Some studies have demonstrated an enhanced expression of large molecular weight HSPs in systematic joints comprised by disease. HSP27 has cytoprotective and biosynthetic functions within chondrocytes and is an oestrogen-associated protein that is under hormonal modulation and its expression seems to be regulated by steroid hormones. This relationship could explain the significant sex difference regarding gender prevalence and clinical manifestations of temporomandibular joint (TMJ) disease. In order to have a better understanding, at a molecular level of the pathophysiology of certain TMJ disorders, an immunohistochemical study was carried out to assess the presence of HSP27 in human TMJ discs.
MATERIALS AND METHODS: Twelve adult human TMJ discs (10 diseased and two normal discs) and five TMJ discs of human foetuses were utilized. The discs and tissues were fixed in 10 per cent buffered formalin and then processed for histological examination. Sections were immunohistochemically stained using the streptavidin–biotin detection method.
RESULTS: Any reaction product for HSP27 in discs of foetuses was assessed. HSP27 was weakly expressed in normal TMJ discs. On the other hand, HSP27 was up-regulated in internal derangement specimens with major histopathological changes. No correlation between gender and HSP27 expression was found in the specimens.
CONCLUSIONS: Although this protein is under hormonal modulation and is involved in mediating sex hormone functions, HSP27 expression in the examined specimens did not provide further indirect evidence for the presence of oestrogen receptors (ER) within human disc cells or explain the conflicting reports about ER presence in the TMJ disc.

127 OUTCOME OF ORTHODONTIC CARE IN 19-YEAR-OLDS ATTENDING THE PUBLIC DENTAL SERVICE IN SWEDEN

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AIM: To analyse residual need and demand for orthodontic treatment in 19-year-olds attending the Swedish Public Dental Service (PDS). General practitioners (GPs) had selected individuals for orthodontic specialist consultation and some were treated by GPs or specialists, or not considered to be in need of treatment. Altogether 164 individuals were called for clinical investigation at the age of 19 years and also given a questionnaire asking for residual orthodontic treatment demand and satisfaction with information and orthodontic care.
RESULTS: Half of the 19-year-olds at the PDS clinic had received an orthodontic consultation and one-third had received orthodontic appliance treatment. Seven per cent of the individuals investigated had a residual subjective demand for treatment. Several individuals who had undergone removable appliance treatment had an overjet and deep bite and laterally a forced crossbite, but with little remaining subjective demand for treatment. Individuals with fixed appliance treatment showed few malocclusions. Nineteen-year-olds in general were uncertain about their present orthodontic treatment need.
CONCLUSIONS: The total amount of orthodontic treatment in different areas in Sweden is comparable but the distribution between GP and specialist treatment differs. Interceptive treatment to reduce overjets in order to decrease traumatic injuries to the anterior teeth seems not to be successful. Fixed appliances appear to reduce the majority of the malocclusion traits. The information given in connection with orthodontic consultation or treatment was clearly inadequate.

128 NON-SURGICAL TREATMENT OF SEVERE SKELETAL CLASS III MALOCCLUSIONS IN THE ADULT OR PERMANENT DENTITION

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AIM: It is well known that skeletal Class III treatment is often considered to be so doubtful that surgical intervention is usually necessary. The purpose of the study was to explore and evaluate the successful treatment effects produced by differential mechanics in mature patients with severe Class III malocclusions.
SUBJECTS AND METHODS: Nine patients with severe skeletal Class III malocclusion who were advised that surgical intervention was necessary, but refused this treatment. The features of the pre-treatment cases were: (1) age range 12–20 years; (2) full or super Class III molar relationship; (3) obvious skeletal Class III pattern (ANB < –2.0 degrees); (4) significantly concave profile; (5) the mandible could not be moved backward. Two lower second permanent molars were extracted in five subjects. The pre- and post-treatment cephalometric measurements were statistically analysed.
RESULTS: A non-surgical approach using the Tip-Edge appliance or other differential techniques was employed in the treatment of these skeletal Class III subjects with favourable results. There was a significant increase of 1.83 degrees in ANB angle ($P < 0.01$). A significant difference in Wits values was observed with an average increase of 5.44 mm. There was a change in the soft tissues with a significant decrease in the distance of the lower lip to H line ($P < 0.05$).
CONCLUSIONS: Differential techniques, such as the Tip-Edge straightwire appliance, are effective non-surgical treatment approaches for severe skeletal Class III malocclusion during the adult or permanent dentition.

129 COMPUTER PREDICTION OF HARD TISSUE PROFILES IN ORTHOGNATHIC SURGERY

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AIM: To analyse the accuracy and reliability of computer predictions generated in patients with severe dentofacial deformities treated by orthognathic surgery using the CASSOS (Computer-Assisted Simulation System for Orthognathic Surgery) 2001 software (2000 SoftEnable Technology Ltd).
SUBJECTS AND METHODS: Forty adult patients who had undergone orthognathic surgery were evaluated. The sample consisted of 15 males and 25 females, mean age 25 years. The pre- and post-surgical lateral cephalographs were scanned into the computer and 71 landmarks were digitized. Digitization error was assessed from repeated digitization. A customized cephalometric analysis consisting of 14 (11 angular and three linear) measurements was used. Student's *t*-tests were performed to identify significant differences between the predicted and actual post-surgical hard tissue measurements at the $P < 0.05$ level.
RESULTS: A good correlation was found between repeated digitization for all measurements. There were no statistically significant differences in 10 of the 14 measurements. Only SNA ($P < 0.05$), U1–L1 ($P < 0.01$), U1–MxP ($P < 0.001$) and U1–SN ($P < 0.001$) showed statistically significant differences between the predicted and actual measurements. However, a maximum mean difference of 3.7 degrees (U1–L1) was noted, which was clinically insignificant.
CONCLUSION: The CASSOS 2001 software provides accurate hard tissue prediction for orthognathic surgical procedures. All 14 variables investigated showed high level reliability. Recent technological advances have made many computer software programs in orthognathic surgery widely available, resulting in faster and easier surgical treatment planning.

130 THE NEURO-OSTEOLOGICAL CEREBELLAR DEVELOPMENTAL FIELD

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AIM: To define the limits of the developmental field of the prenatal posterior cranial fossa housing the cerebellum and brain stem by introducing a neuro-osteological cephalometric fix-point at the upper border of this field. A further aim was to express developmental changes in size and shape during the first half of foetal life.
SUBJECTS AND METHOD: Fifty-three normal human foetuses ranging from 6 to 26 weeks gestation and from 18 to 227 mm crown rump length. Lateral and frontal radiographs were obtained and histological sections were stained with Toluidine-blue for cartilage identification.
RESULTS: The upper posterior border of the developmental field was found at the transition between the chondrally and desmally ossified parts of the occipital squama at the level of the attachment of the tentorium cerebelli. Accordingly the midsagittal limits of the field were: clivus, the chondral part of the occipital squama, and the tentorium cerebelli. During prenatal growth the cerebellar developmental field showed faster vertical growth posteriorly than anteriorly. Corresponding to the growth of the cranial base *in toto* in the midsagittal plane, the posterior cranial base grew slower. The shape of the field changed during growth by widening of the angle between the chondral squama and the base of the occipital bone.
CONCLUSION: The components comprising the cerebellar development field are developmentally interrelated as the notochord plays a decisive role in the formation of bone and brain tissue. As a consequence pathological changes might be expected in both tissue types in syndromes involving the head and neck. The present investigation is a basic study aimed at gaining more information from future cephalometric analysis in orthodontic practice.

131 THIRD MOLAR AGENESIS IN DOWN SYNDROME

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AIM: To determine the frequency of third molar agenesis in a Down syndrome population and reveal gender and intermaxillary differences in this population.
SUBJECTS AND METHOD: Ninety Danes with Down syndrome, 39 females and 51 males, all above 11 years of age. Clinical examination, dental pantomograms, and enoral radiographs were obtained as a part of normal clinical procedures.
RESULTS: The frequency of third molar agenesis was 84.4 per cent (females 87.2 per cent, males 82.4 per cent). Agenesis of third molars was registered more often in the maxilla: 55.7 per cent against 44.3 per cent in the mandible.
CONCLUSION: These results highlight the importance of focusing on the dental germs in the phenotypic discussion, as different genes are involved in tooth formation. The absence of teeth can contribute to an understanding of the interaction between genotype and phenotype.

132 CELLULAR AND MOLECULAR CONTROL OF ROOT RESORPTION

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AIM: The process of tooth resorption is believed to be very similar to that of bone. Receptor for activator of nuclear factor κB ligand (RANKL) has been shown to be central in both osteoclast development and activity. The local amount of RANKL relative to osteoprotegrin (OPG) has been

shown to be important in osteoclast formation and a balance between the two is required, which dictates osteoclast formation and the amount of bone resorption. In certain resorptive bone diseases the RANKL/OPG mRNA ratio increases with increased resorptive processes. The aims of this investigation were: (1) to establish a pilot study to analyse the expression of RANKL as a potential mechanism of recruitment of osteoclasts and osteoclastogenesis in root resorption using a rat model; (2) to correlate the ratio of RANKL/OPG mRNA in the normal dental environment of the rat molar and after force application; and (3) to analyse differences in expression in areas undergoing root resorption.
MATERIAL AND METHOD: Fixed closed coil spring appliances were inserted in Wistar rats for mesial movement of the maxillary right first molar. The left side was used as the control. Tissue was collected from sacrificed mice after 7 days. Amplified extracted mRNA from different areas were analysed for intensity differences and the expression of RANKL was determined by *in situ* hybridisation.
RESULTS AND CONCLUSIONS: Preliminary results suggest a potential for the expression of RANKL as an analysis of the root resorption process. Such studies should improve the current understanding of the biology of tooth movement and root resorption and its correlation with other bone remodelling processes, which could allow improved clinical management of patients during force application.

133 RESISTANCE TO CORROSION IN BRAZED AND LASER WELDED ORTHODONTIC APPLIANCES: AN *IN VITRO* STUDY

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AIM: To compare the corrosion resistance of stainless steel when traditionally soldered, i.e. brazed and when laser-welded.
MATERIALS AND METHOD: (1) Thirty AISI 321 stainless steel band strips and AISI 301 Remanium wire: Group A ($n = 9$) were brazed using solder with incorporated fluid; Group B ($n = 9$) were laser-welded with the solid-state Laser Desktop Dentaurum (Nd:YAG). The control group comprised brazed ($n = 6$) and laser-welded ($n = 6$) samples that were not immersed in corrosive solution. The specimens were immersed in artificial saliva at pH 2.3 for 7 days at 37 ± 1 degrees, according to DIN 13912 specifications. Corrosion was studied by: (1) scanning electron microscopy (SEM) observation of sample surface morphology before (T0) and after standardized immersion test (T1); (2) X-ray microanalysis (EDAX); (3) weight percentage variation assessment (Mettler AT261 delta-range Toledo) of specimens; (4) atomic absorption spectophotometry. *t*-test and ANOVA were performed when necessary.
RESULTS: SEM observation of the brazed samples after immersion showed evident corrosion (intergranular localized corrosion), which was not visible in the laser-welded samples; EDAX of the crystals present in the SEM image of Group A at T1 showed copper chloride, caused by the welding material that made the underlying steel less resistant to corrosion. Both groups showed a weight decrease in the T0–T1 interval, which was statistically significant ($P < 0.001$) only in Group A. Group A released more metals than Group B.
CONCLUSIONS: Laser-welded samples are more resistant to corrosion.

134 CHANGES OF CONTRACTILE PROTEINS IN THE MASSETER MUSCLE AFTER ORTHOGNATHIC SURGERY

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AIM: Orthognathic surgery in adults with Class II or Class III malocclusions is a widely used method to optimize the occlusion, function, and aesthetics. Relapse after surgery is a known problem in which the muscles seem to play a pivotal role. The aims of this investigation were to determine the changes in the molecular structure of the masticatory muscles after orthognathic surgery.
SUBJECTS AND METHOD: The change of myosin heavy chain (MyHC) protein was analysed in a clinical pilot study of 10 patients who had undergone orthognathic surgery. Two regions of the masseter on both sides were examined. Analysis was undertaken immediately following surgery and 6 months post-surgery when osteosynthetic materials were removed. The muscle material was tested after isolation of total protein followed by separation of Type I and II MyHC proteins by SDS-polyacrylamide gel (SDS) electrophoresis and estimation of Type I and II MyHC by Western blot. The relative quantification was carried out by densitometric analysis of the SDS-gels.
RESULTS: Distinct changes in MyHC type composition were measured. Type I MyHC protein was reduced, whereas the protein amount of Type IIa and Type IIx MyHC increased.
CONCLUSIONS: The decrease of the MyHC Type I protein may be a sign of reduced masticatory activity.

135 EFFECT OF HEAD ROTATION ON LATERAL, POSTERO-ANTERIOR CEPHALOMETRIC, AND SUBMENTOVERTEX RADIOGRAPHS

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AIM: To determine the potential projection errors of lateral and postero-anterior (PA) cephalometric and submentovertex radiographs due to head rotation.
MATERIAL AND METHOD: A well-preserved complete human dry skull of an adult with no gross asymmetry. The dry skull was rotated from 0 to ±14 degrees at 2-degree intervals. A vertical axis, the *Z*-axis, was used as a rotational axis to

have 15 lateral and 15 PA radiographs exposed. The skull was tilted on each side again at 2-degree intervals to expose the 15 submentovertex films. The lateral and PA cephalograms were evaluated using Quick Ceph Image Pro Version 3.0.
RESULTS: (1) Angular measurements are more reliable and change less due to projection errors than linear measurements on lateral cephalograms; (2) not only linear but also angular measurements demonstrate variations with changing rotation of the head on PA cephalograms; (3) the findings for submentovertex radiographs were similar to those of lateral cephalograms.
CONCLUSION: Angular measurements of lateral cephalometric and submentovertex radiographs are more useful than linear measurements in minimizing the projection errors associated with head rotation. However, on PA cephalograms, both types of measurement show changes and care should be taken to obtain reliable films and to ensure standardization.

136 THREE-DIMENSIONAL ANALYSIS OF MALOCCLUSION AND MALPOSED TEETH

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AIM: To assess a computerized method for accurate three-dimensional (3D) modelling of dental casts for diagnosis and treatment planning.
MATERIAL AND METHODS: The teeth and occlusion were virtually studied in a computer as 3D patterns, reproduced from the dental casts of 35 patients using a computer programme (3D Dental Studio, Rospatent®, Russia). Data input from the dental casts was carried out using an original 3D-digitizer. 3D-analysis before and after orthodontic treatment of several cases was undertaken by applying fixed and removable appliances such as a positioner. Special focus was given to active action of the appliance/positioner in the correction of the position of teeth.
RESULT: Computed 3D analysis of dental casts allowed precise 3D measurements of the reference planes. Visualization of the 3D patterns of the dentition on an individually designed wire frame was possible, allowing treatment planning and superimposition of the patterns of the dentition before and after treatment. The 3D analysis of the dental casts before and after orthodontic treatment demonstrated the 3D influence of appliances on actively moved and supporting teeth.
CONCLUSION: It is possible to visualize accurately the occlusion and occlusal contact points in a 3D plane before and after treatment and to visualize the plan and results at the start of the treatment.

137 THE 'QUID TEST' IN A POPULATION SEEKING CARE AT AN OROFACIAL PAIN CLINIC

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AIM: To investigate the response pattern to the 'Quid test' (Italian analogue of the McGill Pain Questionnaire) among a subgroup of a population seeking care at an orofacial pain clinic.
SUBJECTS AND METHOD: Two hundred and twenty-nine consecutive patients (mean age 35.9 years) completed the Quid test and underwent a complete clinical examination. RDC criteria were used for temporomandibular disorders (TMD) and IHS criteria for headache and facial pain. An analysis of pain descriptors was also performed. The subjects were divided into six groups according to their clinical characteristics: TMD: pain at the moment of the examination, positive findings for TMD (RDC criteria); eTMD: history of TMD, episodic pain, no clinical findings at the examination; headache (H): main complaint; neck pain (N): main complaint; atypical facial pain (AFP): facial pain not fulfilling other criteria (IHS 12.8); no orofacial pain (NOFP): no pain disturbances. Statistical analysis was performed using *t*- and Chi-square tests with a significance level set at 0.05.
RESULTS: The population distribution among the six groups was: TMD 53.71 per cent, eTMD 9.17 per cent, H 4.80 per cent, N 1.31 per cent, AFP 6.11 per cent, and NOFP 24.89 per cent.
CONCLUSIONS: Significant differences were found in the type and distribution of words chosen: particularly five descriptors showed a significantly different pattern of distribution. Additional significant associations were found for the following clinical variables: pain intensity between H and TMD ($P = 0.034$), and between AFP and eTMD ($P = 0.027$); presence of psychobehavioural factors (axis II) between eTMD and AFP ($P = 0.05$).

138 SYSTEMIC JOINT LAXITY IN A POPULATION WITH TEMPOROMANDIBULAR DISORDERS

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AIM: Systemic joint laxity (SJL) has been considered a potential contributing factor for temporomandibular disorders (TMD) and is significantly more prevalent in patients with anterior disc displacement (ADD). The aim of the present study was to compare the clinical findings of a group of painful TMD patients with those of a pain-free group.
SUBJECTS AND METHODS: Two hundred and twenty-nine consecutive patients referred to an orofacial pain clinic for suspected TMD underwent a standardized clinical evaluation. Two subgroups of this population were analysed: (1) pain at the moment of examination with positive findings for TMD (TMD group); and (2) no orofacial pain (NOFP group): no pain at the moment of the examination, with the main complaint of asymptomatic clicking noise and positive clinical findings for ADD with reduction. The hypothesis of a different prevalence of SJL between the two groups was tested. SJL was diagnosed according to Beighton's test, and TMD according to RDC. The TMD group included 53.71 per cent of subjects, and the NOFP group 24.89 per

cent. Statistical analysis was performed using the *t*-test, with the significance level set to 0.05.
RESULTS: SJL was significantly more prevalent in the NOFP group than in the TMD group (P = 0.021), while cervical problems (neck pain and/or limitation in range of movements) were significantly more common in the TMD group (P = 0.0001). In the TMD group, the hypermobile population (38.21 per cent) was significantly younger (P = 0.0001) and had a lower prevalence of cervical problems (P = 0.03) than the non-hypermobile TMD population.
CONCLUSIONS: This study confirms the association between SJL and ADD with reduction.

139 AN ORTHOGNATHIC TREATMENT PLANNING SYSTEM IN BORDERLINE CASES

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AIM: The Tomac orthognathic treatment planning system (McCollum, 2001) identifies the precise dental movements and surgical repositioning of the jaws that are required to produce the ideal profile and is particularly useful in borderline cases. The aim of this investigation was to contribute towards correlating the response of the soft tissue to the surgical movement of the jaws and teeth.
MATERIALS AND METHOD: One study involved 26 subjects requiring surgical advancement of the maxilla and the other 25 patients who had mandibular advancement. Standard cephalometrics with the lips in repose were taken pre-operatively and 7 months post-surgery. The tracings were digitized on a Kontron videoplan with 23 points recorded on the maxilla and 21 on the mandible. Linear changes were measured to a constructed *x*–*y* axis standardized to a 6-degree angle. Statistical evaluation of repeatability and error analyses were carried out. Correlation of the movements of related hard and soft tissue points identified those having strong interdependence were also confirmed by the coefficient of determination.
RESULTS: In the maxilla the most relevant point was the upper incisor tip. Movement of the nose tip was 26 per cent, subnasale 56 per cent, superior sulcus 65 per cent, and labrale superius 55 per cent of the movement of the upper incisor tip. In the mandible the paired hard and soft tissue points correlated well; the soft tissue chin contour responding in a close 1:1 ratio while lower lip responded to lower incisor tip movement at a ratio of 77 per cent. Multiple regression analysis also included variables such as tissue thickness and VY closure, e.g. ΔLs-h = –1.23 (ΔUIT-h) + 3.24 (TT) and ΔLi-h = –0.10 + 0.58 (ΔLIT-h) –0.44 (TT).
CONCLUSIONS: The Tomac treatment planning system is based on a determination of the most desirable soft tissue profile. The data enhance the accuracy of prediction of the hard tissue movements that produce that profile and is a decisive tool in planning treatment in borderline cases.

140 COMPLETE DISTALIZATION OF THE UPPER ARCH BY TIPPING AND UPRIGHTING: TECHNIQUE EVALUATION

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AIM: To evaluate a new non-extraction method of treating Class II division 1 malocclusions.
SUBJECTS AND METHOD: Sixteen patients were treated using this method; initially all had Class II division 1 malocclusions with Class II molar relationships and mild to moderate lower arch crowding, which did not require extractions. Begg brackets were used in the upper arch and pre-adjusted edgewise brackets in the lower arch. Cement was placed on the second molars to aid overbite reduction. The technique can be divided into four phases: 1. After initial alignment a lower 0.019 × 0.022-inch steel wire is placed in the lower arch and 0.016-inch steel wire with circle hooks mesial to the canines is placed in the upper arch. 2. The occlusal interferences are removed by placing polycarboxylate cement on the lower second molars, which allows the first molars to freely erupt and aids overbite reduction. Light Class II elastics together with uprighting springs to distalize the premolars and canines are also used at this stage. 3. The upper arch is extended to the second molars and a Nance placed to reinforce anchorage; upper torquing auxiliary and uprighting springs are used with light Class II elastics. 4. Finishing stage.
RESULTS: Fifteen patients showed full overjet reduction. In one subject overjet reduction was not fully achieved in phase II and the upper first premolars were extracted. His treatment was subsequently completed successfully. In the 15 patients treated non-extraction there was a mean reduction in overjet from 12 to 2.37 mm with no increase in maxillary mandibular plane angle. The final averages for upper incisor inclination: 103.9 degrees; lower incisor to APo: 0.73 mm; ANB: 4.6 degrees.
CONCLUSION: This method provides an alternative treatment, which demonstrates efficient anchorage control and enables early and effective reduction of overbite, which is not always possible with other techniques.

141 DENTAL AGE ESTIMATION AND THIRD MOLARS: A PRELIMINARY STUDY

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AIM: To determine the chronological age of a living individual based on the dental development of one or more third molars as viewed on a dental pantomogram (DPT).
MATERIALS AND METHOD: One thousand one hundred and eighty-seven DPTs were assembled from patient files. The selection criteria were: no medical history, no dental pathology present on the radiographic image, at least one third molar present, Caucasian origin (Belgian whites), patients between the ages of 16 and 22 years. A distinction

was made between males (n = 501) and females (n = 686). Fifty DPTs were scored by two observers at two intervals separated by two weeks in order to evaluate inter- and intra-observer reliability. Scores (1 to 10) were attributed to each third molar present based on its dental development according to the developmental stages reported by Gleiser and Hunt (1955). The SAS statistical analysis software package was used (SAS Institute, Cary, NC, USA). Kappa statistics were used to determine intra- and inter-observer effects. Multiple regression analyses were performed and probabilities were calculated.
RESULTS: No intra- or inter-observer effects were found. Statistical analysis resulted in multiple regression formulae for both males and females with the dental developmental stage of the third molars as variables. It seems that the third molars may account for 49 and 39 per cent, respectively, of the variation in chronological age for males and females (r^2). Standard deviations for males and females of 1.62 and 1.59 years, respectively, were found.
CONCLUSION: Chronological age of individuals may be estimated within 37 months for males and females with 95 per cent confidence intervals.

142 INFLUENCE OF HYPODONTIA ON DENTAL ARCH DEVELOPMENT

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AIM: To examine the influence of congenital absence of one or more teeth on the sagittal and transverse development of the dental arch in patients with hypodontia.
MATERIALS AND METHOD: Twenty pairs of study models of children with hypodontia (10 males, 10 females), with a mean age of 10.8 years (range 8–15 years) were compared with 20 pairs of study models of children with a full dentition and normal occlusion (10 males, 10 females) mean age 10.5 years (range 8–15 years). The average number of missing teeth was two (range 1–7 excluding third molars). The congenital absence of teeth was determined by clinical and radiographic examination. The height of the dental arches as well as the anterior and posterior maxillary and mandibular arch width were measured directly on the plaster dental casts.
RESULTS: There was a significant reduction in the size of the dental arches in patients with hypodontia, except for mandibular arch width. There were statistically significant differences in anterior maxillary and mandibular dental arch width ($P < 0.001$) and posterior maxillary arch width ($P < 0.001$) between the two groups. There were no significant differences between the groups for posterior mandibular arch width ($P > 0.05$). The sagittal measurements showed a statistically significant difference between the two groups.
CONCLUSION: Congenital absence of teeth leads to aesthetic, phonetic, and functional disturbances and must be taken into consideration in orthodontic treatment planning.

143 THE RISK OF ROOT RESORPTION DURING ORTHODONTIC MOVEMENT OF SEVERELY TRAUMATIZED INCISORS

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AIM: To evaluate the risk of root resorption during orthodontic treatment after severe dental trauma to the incisors.
SUBJECTS AND METHODS: Fifteen patients (10 girls, five boys) with 34 severely injured incisors with complete records from the trauma episode and follow-up were studied. Seven incisors were extracted and 27 moved with fixed appliances. The age at the time of injury was 8.2–16.2 years (mean 11.2 years). The follow-up period prior to orthodontic treatment was 0.8–6.5 years (mean 4.0 years). The orthodontic treatment lasted from 0.6 to 3.4 years (mean 1.6 years). Intra-oral radiographs taken at the time of trauma, at the start of, and after orthodontic treatment were evaluated. An index with scores from 0 to 4 was used for the evaluation. Each tooth was evaluated on at least two radiographs and double determination was made of all radiographs. In order to standardize the method, 15 patients from an earlier study, randomly selected, were evaluated and good agreement with earlier registrations was found.
RESULTS: At the start of orthodontic treatment 14 teeth showed no resorption. In seven of these no resorption developed, in three minor and in four moderate resorption occurred during treatment. Before treatment five teeth had minor resorption, four developed moderate and one severe resorption during treatment. The three teeth with moderate resorption and the five teeth with severe resorption before treatment were unchanged after treatment.
CONCLUSIONS: In a severe trauma event, teeth with a poor prognosis have to be extracted. The remaining injured teeth properly treated and with a good prognosis might be moved with minor risk of root resorption.

144 LONGITUDINAL CHANGES IN TEMPOROMANDIBULAR JOINT FUNCTION IN YOUNG ADULTS

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AIM: To investigate longitudinally possible changes in temporomandibular joint (TMJ) function in young adults.
SUBJECTS AND METHOD: Ninety-one consecutive dental students were surveyed over a 3-year period. Anamnestic data were collected using a questionnaire. The condition of the TMJs and the masticatory musculature was assessed by means of the Manual Functional Analysis (active jaw movements, orthopaedic joint tests, and isometric muscle contractions). The examination was performed in the first (T1) and sixth (T2) term of dental training.

RESULTS: Signs and symptoms of temporomandibular disorders (TMD) were reported by about 60 per cent of the individuals. The prevalence of subclinical TMD was 16.5 per cent at T1 and 15.4 per cent at T2, and of clinical TMD 19.8 per cent at T1 and 24.2 per cent at T2. Clicking and/or crepitation proved to be the only reported sign with a significant interrelationship with the clinical findings. The prevalence of all signs and symptoms of TMD fluctuated over the 3-year period. Although there was a tendency for an increase in clinical TMD, no significant changes in prevalence were found. The incidence rate was 10 per cent for both clinical and subclinical TMD.
CONCLUSION: As one in 10 young adults is prone to develop clinically manifest TMD over a 3-year period, for therapeutic or forensic reasons, a systematic TMD screening should be performed in all adult patients before as well as during the course of orthodontic treatment.

145 RAPID MOLAR DISTALIZATION WITH A HYRAX SCREW SUPPORTED BY A LIP BUMPER

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AIM: To evaluate the effects of a new device that has a hyrax screw for distalizing molars and a lip bumper for anchorage control.
SUBJECTS AND METHOD: Nine patients (three males, six females) with a mean age of 15.4 years, all with a Class II molar relationship. Upper second premolars and first molars were banded and a hyrax screw was adjusted to these bands to open up a space between these teeth. To control the mesial force vector on the second premolar, a lip bumper was inserted through the buccal tube and fixed with a wire. Markers (1.1 mm wire) were soldered to the buccal surface of the molar bands for precise measurements on the radiographs. The lip bumper was adjusted in every patient as high as possible in the sulcus to exert the optimum force with the least disturbance to the surrounding tissues. After cementation the patients were instructed to open the screw twice a week. Following completion of distalization the appliance was removed and a Nance device was inserted for retention. The study was carried on lateral cephalometric films and dental model casts taken before, immediately after, and at the end of the 3-month retention period of distalization.
RESULTS: The upper first molars moved bodily in a distal direction (4.5 mm) in 5 months while the second premolars moved forward (4.1 mm) due to the mesial force vector of the device. However, at the end of the 3-month retention period the second premolars had moved distally probably due to strained transeptal fibres.
CONCLUSION: The device seems very effective but anchorage loss at the second premolars was greater than expected, indicating that the rate of activation during distalization should be re-evaluated.

146 OPINIONS OF AFRICAN CHILDREN ON DENTAL AESTHETICS USING THE AESTHETIC COMPONENT OF THE INDEX OF ORTHODONTIC TREATMENT NEED

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AIM: To investigate the opinion of Tanzanian children towards dental attractiveness based on the 10 intra-oral Index of Orthodontic Treatment Need (IOTN) photographs and eight additional intra-oral photographs, and to correlate the children's opinions about the 18 photographs with their clinical IOTN grade, gender, and age.
SUBJECTS AND METHODS: Three hundred and ninety-seven African children of whom 206 (52 per cent) were girls and 191 (48 per cent) were boys, aged 9–18 years. A pre-structured questionnaire with photographs was administered to the children. They were asked to rate dental attractiveness on a five-point scale for each photograph. Factor analysis, *t*-test, multiple regression, and ANOVA were used to analyse the data. Factor analysis reduced the 36 opinions (18 photographs, two questions) to four factors: (1) ideal photographs; (2) spacing photographs; (3) open bite and spacing photographs; and (4) crowding photographs.
RESULTS: Generally children regarded crowding as unattractive. The occlusion on the 'ideal' photographs was generally regarded as attractive while the mean of the opinions for 'spacing' and 'spacing and open bite' fell in the middle of the scale with a tendency towards unattractiveness. Only the opinion about crowding was correlated with age ($P < 0.016$) and gender ($P < 0.05$) of the participants. Older children and girls tended to dislike crowding, the most. The child's own grade for the IOTN Aesthetic Component had no significant influence on the opinion of the child.
CONCLUSION: Children regarded crowding as the most unattractive malocclusion, suggesting that from the patient's point of view space deficiency anomalies could be given first priority when considering a nationwide orthodontic treatment policy in this society with limited resources.

147 PERENNIAL ALLERGIC RHINITIS AND THE VERTICAL DIMENSIONS OF CHILDREN'S FACES

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AIM: To evaluate the relationship between perennial allergic rhinitis (PAR) and the increase of facial divergence.
SUBJECTS AND METHODS: Forty patients, 9–16 years of age, divided into two groups: (a) 20 patients (10 males, 10 females) with PAR (mean age = 12.35 years) and (b) a control group of 20 subjects (10 males, 10 females) without any respiratory problem (mean age = 12.20 years). Each

patient was subjected to a clinical orthodontic examination and a questionnaire (by the same orthodontist); a rhinomanometric measurement to assess mode of respiration (by the same allergologist); and a lateral cephalogram. The five values of the Biggerstaff's (1977) vertical analysis were used: total facial height divergence, respiratory level divergence, digestive level divergence, upper dentoalveolar level divergence, and lower dentoalveolar level divergence. Each PAR patient was matched with a control patient with respect to age and sex. Statistical analysis was carried out with a Student's *t*-test.
RESULTS: The digestive level divergence was found to be significantly increased in PAR patients compared with controls. No significant difference was found for the four other measurements.
CONCLUSIONS: PAR seems to increase divergence of the digestive level in children. It is likely that obstruction of the nasal airways induces a postural craniocervical adaptation in extension and a lowering of the mandible that results in an increase of lower face height.

148 PSYCHOLOGICAL FACTORS OF YOUNG ORTHODONTIC PATIENTS WITH TEMPOROMANDIBULAR JOINT DYSFUNCTION

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AIM: It is important to monitor psychological factors in orthodontic patients with temporomandibular joint dysfunction (TMD), which is a multi-factorial disorder. The purpose of this study was to clarify the difference in psychological factors between young and adult patients using a psychological test, the TMJ Scale® (Pain Resource Center Inc., Durham, USA).
SUBJECTS AND METHOD: Two groups of patients, a young group of 16 subjects (mean age 13 years 6 months) and an adult group of 16 patients (mean age 25 years 3 months). They answered the questionnaire before their treatment. The TMJ Scale comprises 97 multiple choice questions with five possible answers per question.
RESULTS: The results were compared between the two groups for pain report, joint dysfunction, perceived malocclusion, non-TMD, and range of motion limitation, as physical parameters. Psychological factors and stress were included as the psychosocial parameters, and global as the global parameter. The young group showed higher scores in almost all parameters than the adult group except for perceived malocclusion, where a significant difference was observed between the two groups at the 5 per cent level. No significant difference was found for the other parameters.
CONCLUSIONS: Awareness of malocclusion was lower in the young patients than in the adults, whilst the TMD symptom might be higher than in the adult group. It is necessary to consider these psychological differences when treating young orthodontic patients with TMD.

149 REPRODUCIBILITY AND DEGREE OF RELIABILITY OF NATURAL HEAD POSTURE AND NATURAL HEAD ORIENTATED PROFILE PHOTOGRAPHY

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AIMS: To investigate the standard deviation (SD) of photographic norms using the natural head position (NHP) method, the degree of reproducibility of photoregistered and photoestimated NHP, and the degree of reliability in the NHP and natural head orientated (NHO) photographic method.
SUBJECTS AND METHOD: Thirty-nine male dental school students between the ages of 20 and 39 years. All types of occlusion and facial profiles were included. Two profile photographs of all 39 subjects (including the chain at the side of the skull with the subjects looking at their eyes in a mirror) were obtained with a 13–68 minute interval. Each photograph was traced and landmarks and extracranial references were marked [true vertical (TV), true horizontal, and Ricketts' aesthetic Line (E-line)]. The angle between the E-line and TV on the two photographs was measured and compared for evaluation of the reproducibility of the photoregistered and photoestimated NHP. The percentage reliability of the two methods was also compared.
RESULTS: The SD of the norms decreased by 2 degrees compared with conventional norms. Reproducibility showed a high degree of consistency for photographic NHP.
CONCLUSION: (1) The NHP method is a more reliable reference. (2) The NHP method has a high correlation coefficient ($r = 0.87$; $P < 0.01$) and thus a high degree of reproducibility. (3) The photoestimated NHP has a high correlation coefficient with photoregistered NHP. (4) The method error for NHP was 1.49–1.83 degrees and for NHO 1.77–2.32 degrees. NHO is therefore a more reliable reference compared with NHP ($r = 83$; $P < 0.01$)

150 EVALUATION OF DENTAL ARCH MORPHOLOGY IN 9–13-YEAR-OLD CHILDREN

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AIMS: To evaluate the morphology of the dental arches, and to correlate and compare arch form with and between sexes.
SUBJECTS AND METHOD: Two thousand students selected by simple randomized sampling. After clinical examination 61 subjects (35 girls, 26 boys) aged between 9 and 13 years with normal occlusion, an aesthetic profile and symmetrical face without previous trauma, jaw fractures, temporomandibular disorders, or a previous history of orthodontic treatment or orthognathic surgery were selected. Study models and occlusograms were obtained of all subjects. The occlusograms were traced and the variables lower

arch width (LAW), lower palatal width (LPW), lower arch length (LAL), lower palatal length (LPL), upper arch width (UAW), upper palatal length (UPL), palatal height (PH), palatal index (PI), and SIU and SLL were measured. The means and standard deviations were calculated using Excel 97 and the validity level of the measurements was determined using SPSS-6 for Windows. Finally a Student's *t*-test was performed on all measurements to determine significance.
RESULTS AND DISCUSSION: The mean of all measurements was larger in boys, except for PH and PI, which were larger in girls. Upper palatal width: between all variables only six (LPL, LPW, LAW, UAW, UPW, UPL) were significant in boys and girls. The mean dimensions of the lower arch variables such as LPL ($P < 0.005$), LPW ($P < 0.005$), and LAW ($P < 0.05$) were significant. The mean dimension of the upper arch variables such as UAW ($P < 0.005$), UPW ($P < 0.005$), and UPL ($P < 0.01$) were significant. The most negative correlation coefficient with a validity level of 99 per cent was between UAW and PI, which is statistically important.

151 ANALYSIS OF THE MECHANISMS OF ORTHODONTIC TOOTH MOVEMENT USING OSTEOPROTEGERIN-DEFICIENT MICE

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AIM: Osteoprotegerin (OPG) is a novel secreted member of the TNF receptor superfamily that negatively regulates osteoclastogenesis. Receptor activator of NFKB ligand, RANKL, is one of the key regulatory molecules in osteoclast formation and binds to OPG. The aims of this study were to determine whether OPG and RANKL are involved in alveolar bone remodelling during orthodontic tooth movement. RANKL localization and osteoclast induction in periodontal tissues were examined during experimental movement of incisors in OPG-deficient mice.
MATERIAL AND METHODS: Eight-week-old OCIF/JcL OPG (–/–) mice and their wild-type OPG (+/+) littermates were used. To produce orthodontic force, an elastic band was inserted between the upper right and left incisors for 2 or 5 days, and the dissected maxillae were examined for cytochemical and immunocytochemical localization of TRAP, vacuolar-type H^+-ATPase and RANKL.
RESULTS: Compared with wild-type OPG (+/+) littermates, TRAP-positive multinucleated cells were markedly and significantly induced in the periodontal ligament (PDL) on the compressed side and in the adjacent alveolar bone of OPG-deficient mice. These multinucleated cells exhibited intense vacuolar-type H^+-ATPase along the ruffled border membranes. Because of accelerated osteoclastic resorption in OPG-deficient mice, alveolar bone was severely destroyed and partially perforated at 2 and 5 days after force application. In both wild-type and OPG-deficient mice, RANKL expression became stronger at 2 and 5 days after force application than before force application. There was no apparent difference in intensity of RANKL expression between OPG (+/+) littermates and OPG-deficient mice. In both wild-type and OPG-deficient mice, expression of RANKL protein was detected in osteoblasts, fibroblasts, and osteoclasts mostly located in resorption lacunae.
CONCLUSIONS: OPG and RANKL are important determinants to regulate bone remodelling in the periodontal tissue during orthodontic tooth movement, and osteoblasts/stromal cells and PDL fibroblasts are involved in supporting osteoclast differentiation during tooth movement.

152 INTRA-ORAL ASSESSMENT OF MALOCCLUSION IN MIXED DENTITION SUBJECTS

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AIM: To evaluate the numerical assessment of malocclusion of 10 morphological signs measured intra-orally and to assess malocclusion severity.
SUBJECTS AND METHOD: One hundred 8-year-old school children randomly selected from the population of Maribor in Slovenia (580 children), none of whom had been orthodontically treated. Registrations according to the modified Eismann index for mixed dentition (Farčnik *et al*., 1985) were used and evaluated. All 10 morphological signs were scored and the total malocclusion score for each subject was calculated. The subjects were categorized into four grades of malocclusion severity. Stepwise multivariate regression was used to evaluate the significance of each morphological sign for the total malocclusion score.
RESULTS: The mean total malocclusion score was 18.1 (median 14; range 1–81). Fifty per cent of the subjects scored under 15 (no significant malocclusion); light malocclusion (15–29) was found in 31 per cent, medium/severe in 9 per cent, and severe/very severe (over 45) in 8 per cent. Stepwise regression yielded the following hierarchical order of significance of signs: open bite, crossbite, upper incisor crowding, overjet, axial inclination, rotation, singular antagonism in the sagittal plane, singular antagonism in the transverse plane, midline deviation, and overbite. The first five morphological signs contributed to over 95 per cent of variance of the total malocclusion score.
CONCLUSIONS: According to the above findings rationalization of the modified Eismann index for malocclusion assessment in the mixed dentition is proposed. Instead of evaluating the measurements of the 10 morphological signs, the quantitative assessment of malocclusion could be based on five significant morphological signs only, measured intra-orally. These five signs are a sufficiently reliable indicator of pathology in the quantitative estimation of malocclusion assessment.

153 COULD TEMPOROMANDIBULAR DYSFUNCTION SIGNS BE PREDICTED BY EARLY MORPHOLOGICAL OR FUNCTIONAL VARIABLES?

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AIM: To evaluate whether early signs of different orofacial dysfunctions, malocclusions, or occlusal interferences could predict the development of temporomandibular dysfunction (TMD) in young adults.
SUBJECTS AND METHOD: Fifty-two young adults with and 45 subjects without speech disorders who participated in all four stages of this longitudinal study. The subjects were examined at the ages of 7, 10, 15, and 19 years. The following methods were used: Björk *et al*. (1964) as modified by Laine (1984) for occlusion, Helkimo (1974), and Ettala-Ylitalo (1987) for signs of TMD and mandibular mobility, Remes articulatory test (1975) for speech, and Qvarnström (1993) for oral motor skills. Multiple logistic regression models were fitted in order to evaluate whether single signs of TMD at the age of 19 years were related to previous/present malocclusions or interferences, to misarticulations of speech, problems in oral motor skills, or other signs of TMD. The effect of gender was also considered.
RESULTS: Among 19-year-olds mesial molar occlusion was positively associated with jaw deviation on opening, and a large overjet in almost every stage seemed to be a risk factor for palpatory tenderness of the muscles. In young adults protrusive interferences were positively but mediotrusive contacts negatively related to clicking. Speech disorders and problems in oral motor skills were associated with TMD signs but these fluctuated. Certain signs of TMD were related to each other. In addition, femininity seemed to increase the risk of TMD.
CONCLUSIONS: Girls are more likely to suffer from TMD than boys. A large overjet was the only variable that seemed to increase the risk of TMD systematically. Although during growth there were periodically both local and central factors associated with TMD development, the predictive value of these variables in the estimation of individual risk of TMD seems to be modest.

154 MAXILLARY AND MANDIBULAR SAGITTAL POSITION EVALUATION USING TEN DIFFERENT CEPHALOMETRIC ANALYSES

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AIM: The simultaneous assessment and evaluation of maxillary and mandibular sagittal position by means of 10 different cephalometric analyses in order to investigate the possible diagnostic similarities and/or differences between them.
MATERIALS AND METHOD: Seventy-two lateral cephalometric radiographs of previously treated patients with different types of malocclusions. All cephalometric radiographs were traced, digitized, and analysed using the cephalometric software (Viewbox) after appropriate adjustment. The cephalometric analyses used included: Downs, Tweed, Steiner, Ricketts, Jarabak, Wits, Burstone, McNamara, Humboldt University (Berlin), and Aristotle University (Thessaloniki). Thirty-eight variables were used to describe (a) the maxillary and mandibular sagittal position in relation to the anterior cranial base (SN) and the Frankfort plane (FH), and (b) sagittal maxillo-mandibular relationships. Statistical analysis was performed by means of the statistical software SPSS, including paired *t*-tests, Kappa (κ), Spearman's rho, and cluster analysis (level of significance $P < 0.05$). For method error estimation, the whole evaluation was repeated after 4 weeks in 40 randomly selected cases.
RESULTS: According to the cluster analysis, three different groups of variables associated with the two reference planes SN and FH were formed. The evaluation of these three groups revealed that maxillary and mandibular position seemed to be more protrusive when the FH plane was used, and more retrusive when the SN plane was used. Both ANB angle and Wits appraisal described the sagittal maxillo-mandibular relationships in the same manner.
CONCLUSIONS: It appears that various cephalometric analyses cannot produce similar diagnostic evaluations concerning the maxillary and/or mandibular sagittal position, when different reference planes are used, while ANB angle and Wits appraisal can be used in order to describe sagittal maxillo-mandibular relationships.

155 A MORPHOLOGICAL STUDY OF THE CRANIOFACIAL COMPLEX DURING THE SECOND HALF OF PRENATAL LIFE

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AIM: To investigate the growth rate and relationship of the cranial base and jaws during the second half of prenatal life. The orientation and dimensional changes of certain anatomical elements reveal the pattern of skeletal maturity of the developing craniofacial complex.
SUBJECTS AND METHOD: Twelve spontaneously aborted human foetuses all of which were without any abnormalities. Gestational age ranged from 16 to 28 weeks and crown rump length (CRL) between 140 and 280 mm. The foetuses were preserved in 10 per cent formalin and then the heads were removed by decapitation at the level of the hyoid bone. After specific demarcation of the midline, a midsagittal section was performed. Metallic indicators for the recognition of certain landmarks were used. Lateral standardized radiographs were taken of every half head from a distance of 1 m. Every half head was then positioned on the cassette with the S–N plane coinciding with the horizontal line. The radiographs were analysed by employing linear and angular measurements, and the data were analysed using descriptive and correlation statistics.

RESULTS: Some of the findings of the analyses were: the cranial base angle was found to be strongly negatively correlated to SNA and SNB, and the gonial angle was highly positively correlated to nasolabial angle.
CONCLUSION: From the above and other findings it can be assumed that the basic growth pattern and the pattern of the relationships between the jaws and the posterior and anterior cranial base are established and standardized during the second half of prenatal life.

156 VALIDITY OF MEASUREMENTS ON VIRTUAL MODELS CREATED FROM PLASTER CASTS OR IMPRESSIONS

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AIM: To test the accuracy of measuring computerized casts with the aid of OrthoCad, when three-dimensional (3D) virtual models are created from plaster casts or from impressions.
MATERIAL AND METHOD: Ten set-ups using artificial teeth corresponding to various malocclusions were created, and 10 plaster models from orthodontic cases were also used. Impressions were taken from the set-ups, providing 10 plaster and 10 (A models) 3D virtual orthodontic models. Ten plaster casts from orthodontic cases were also used for the creation of another 10 (B models) virtual models. Measurements of mesiodistal tooth dimension, as well as upper and lower intercanine and intermolar widths were made. Additionally values of mesiodistal tooth width were calculated from the isolated artificial teeth removed from the set-ups, and of the corresponding arch widths from the existing set-ups. The last values were compared with the values from measurements on A models, in order to establish how well measurements with callipers correspond to 'reality'. The values from the measurements on the set-ups and the plaster casts using callipers were then compared with the values from the A and B models to investigate any existing difference.
RESULTS: Measurements performed with callipers were highly valid and reproducible for both tooth size and arch width. Concerning the measurements on A and B models, both exhibited high accuracy and reproducibility, with the B models performing insignificantly better concerning tooth size.
CONCLUSIONS: The OrthoCad measurement tool showed high accuracy and reproducibility, independently of whether the 3D virtual models were created from impressions or plaster casts.

157 MODIFICATION OF THE CONDYLE–DISC–FOSSA RELATIONSHIP AFTER ATM STABILITY WITH SPLINT THERAPY

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AIM: To verify, by means of Panadent instrumentation, the change of condyle–disc–fossa relationship after ATM stability acquired with Roth's splint therapy.
MATERIALS AND METHOD: A screening protocol was performed on growing patients who asked for orthodontic treatment for aesthetic reasons. Diagnostic data included an orthodontic and gnathologic assessment, together with photographs, casts, and full anamnestic surveys. An articulator with face bow and a condyle positioner indicator (CPI; Panadent) were employed for ATM screening to verify the correct condylar positions before, during, and after stabilization therapy performed with an upper total covering splint according to the Roth technique. The start articulator mountings were realized with centric relation (CR) registered using the 'Power Centric' technique and with a centric occlusion (CO) bite wax according to Roth's procedure. The procedure was completed with evaluation of the CO–CR discrepancy with the CPI III Panadent.
RESULTS: All patients treated and stabilized with the splint showed a significant replacement of the condyle–disc complex in the glenoid fossa. The treatment plan differed from the cases analysed in the CO position.
CONCLUSIONS: Orthodontic treatment for patients with temporomandibular dysfunction must be undertaken following stabilization of the stomatognathic system and with CO and CR coincident.

158 DOES HERBST APPLIANCE TREATMENT INFLUENCE OR RESTRICT THE NASOPHARYNGEAL AIRWAY?

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AIM: It has been postulated that functional treatment carried out with headgear can retain or move the maxilla posteriorly and thus permanently diminish the nasopharyngeal airway space region. Orthodontic treatment can therefore cause obstructive sleep apnoea (OSA). The object of this study was to determine the clinical effects on the nasopharyngeal region and nasopharyngeal airway in subjects treated with the Herbst appliance.
SUBJECTS AND METHODS: One hundred Herbst patients (64 girls, 36 boys) treated in the period of puberty to adulthood, and followed long-term until endochondral growth had ceased. Standardized material was collected and measured pre- and post-treatment and 1 year post-treatment. Cephalograms and images of the dental arches were digitized and assessed using the TIOPS computer program. Treatment effects were assessed and analysed using the methods of Björk and Solow. Sagittal airway size and air volume were measured at the narrowest distance between the maxillary tuberosity and the adenoid prominence, and the distance between the distal aspect of the hard palate and the adenoid prominence.
RESULTS: Each patient showed, individually, a more or less assessable treatment effect on the sagittal nasopharyngeal airway size and volume. Generally, size and air volume was impeded during treatment, but increased after treatment. Treatment effects were most pronounced in younger individuals at puberty, but were not registered in adults.

CONCLUSION: Herbst appliance treatment restricts growth of the sagittal nasopharyngeal airway size and volume during treatment in growing individuals.

159 DIAGNOSTIC VALUE OF RADIOGRAPHS FOR TEMPOROMANDIBULAR JOINT INVOLVEMENT IN PATIENTS WITH JUVENILE IDIOPATHIC ARTHRITIS

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AIM: Arthritis of the temporomandibular joints (TMJs) is often a feature in juvenile idiopathic arthritis (JIA) patients and the growth disturbances of the craniomandibular complex are well known. Diagnostic criteria for TMJ arthritis are difficult to outline since symptoms and clinical findings are sparse. TMJ involvement is often defined by radiographic changes of the joint, although a recent study suggests inflammation in the TMJ to be of high frequency (Küseler *et al*., 1998). Inflammation of the TMJ without radiographic changes could be suspected to be detrimental to mandibular growth as well as major radiographic changes. This study compared radiographic findings on dental pantomograms (DPTs), which are often used to diagnose and define TMJ arthritis joint, to magnetic resonance imaging (MRI) findings. The aims were to describe the value of DPTs in the diagnosis and estimation of the development of condylar destruction in the TMJ in children with JIA.
SUBJECTS AND METHODS: Fifteen consecutively selected patients with JIA not lasting longer than 3 years were chosen for this longitudinal study. Four MRI and DPT examinations were carried out with a 6-month interval. The MRIs were obtained with an intravenous injection of a contrast medium to reveal inflammation and described according to soft tissue and bone changes. The DPTs were described according to the degree of condylar resorption.
RESULTS: Thirty per cent of the patients had condylar resorption according to the DPT but no changes were seen in the 2-year period. With MRI 58.6 per cent showed statistically significant erosions at the first examination ($P < 0.05$, Chi^2-test) increasing to 80 per cent at the last examination.
CONCLUSION: The diagnostic value of DPTs, which is an often used screening method, is too low and cannot be recommended to determine early TMJ involvement. It should also be emphasized that early diagnosis is a condition of the success of functional treatment.

160 MORPHOLOGICAL PARAMETERS AS PREDICTORS OF SUCCESSFUL CORRECTION OF CLASS II DIVISION 2 MALOCCLUSIONS

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AIM: To assess pre-treatment cephalometric parameters and measurement of the size of the apical bases as predictors of successful orthodontic correction of Class II division 2 malocclusions.
MATERIAL AND METHODS: Pre- and post-treatment lateral cephalograms and study models of 96 completed Class II division 2 subjects were examined to obtain 23 cephalometric parameters used in McNamara and Schwarz analyses, and to measure the size of the apical bases (Sergl *et al*., 1996). The success of occlusal correction was evaluated as the percentage change in the Peer Assessment Rating (PAR) scores during treatment, which was used as the dependent variable in multivariate statistical analyses testing the predictive value of the morphological parameters assessed.
RESULTS: All pre-treatment cephalometric parameters of craniofacial morphology assessed were poor predictors of successful correction of Class II division 2 malocclusions. Measurement of the size of the maxillary apical base had a significant predictive value for improvement of the PAR scores ($r^2 = 0.059$, $P < 0.05$).
CONCLUSION: The tested cephalometric parameters of pre-treatment craniofacial morphology are negligible as predictors of successful correction of Class II division 2 malocclusions. Assessment of the size of the maxillary apical base was the strongest predictor of occlusal correction achieved and may serve as a valuable diagnostic addition in prediction of successful treatment outcome.

Sergl H, Kerr W J, McColl J H 1996 A method of measuring the apical base. European Journal of Orthodontics 18: 479–483

161 NON-INVASIVE CHARACTERIZATION OF MASSETER AND ANTERIOR TEMPORALIS MUSCLES: LOCATION OF INNERVATION ZONES BY SURFACE ELECTROMYOGRAPHY

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AIM: Surface electromyography (sEMG) for the non-invasive analysis of the masseter and anterior temporalis muscles has been used in research and clinical applications to provide information relating to musculoskeletal conditions, physiological evaluation, and masticatory function. The results of such studies demonstrate the utility of sEMG in the investigation of muscle function. However, advances in sEMG techniques provide a clear indication that refinement of electrode location relative to innervation zones (IZ) is required in order to optimize the accuracy and relevance of sEMG signals obtained in clinical and research settings. The aim of this study was to identify the IZs for the masseter and anterior temporalis and provide guidelines for positioning of electrodes in future clinical and research applications.
SUBJECTS AND METHOD: Myoelectrical signals were acquired from the deep and superficial head of the masseter and the anterior temporalis bilaterally, during isometric contractions (MVC) in 12 healthy volunteers subjects

(nine males, three females, mean age 27 years). An original electromyograph and an original electrode array (16 electrodes; interelectrode distance = 2.5 mm) were used to detect myoelectric signals.
RESULTS AND CONCLUSIONS: The position of the IZ was consistently in the superior portion of the anterior temporalis and in the inferior part of the masseter muscle. The anatomy suggests the necessity of electrode array use for non-invasive assessment of these muscles. The outcome of this research has facilitated the establishment of recommendations for sensor placement. Guidelines have been established to assist investigators and clinicians in future EMG applications to ensure the consequent results are optimized with improved validity.

162 DECISION MAKING IN SURGICAL-ORTHODONTIC BORDERLINE CASES

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AIM: To establish a decision-making standard of diagnosis-therapeutics based on the observation, quantification, and analysis of different factors, in various groups.
MATERIAL AND METHOD: After definition of 12 variables, submitted to various correlative and multi-dimensional analyses, three groups were constructed, ordered in consonance with actual orthodontic objectives and individual demand. The structuring of the model was based upon progressive quantification of the total severity of the anomalies with multifactor analysis. This proved that it is possible to establish a quantified correlation between the deviation degree, the degree of clinical difficulty, and the clinical age for each factor considered. The validation of the model was based on a retrospective study comparing these decisions with those obtained clinically, in cases that did not offer any decision difficulty. The clinical deliberations that are undertaken in borderline cases were then evaluated. To prove these propositions 60 cases were selected, 25 orthodontic, 20 surgical, and 15 borderline.
RESULTS AND CONCLUSIONS: The method permitted a finding of a referential value (severity index = 1.5) that separates the two main options of treatment: orthodontics or surgery. The method proposed consists of algorithmic decision-making that is versatile and its accessibility permits its use as software. The validated model presents a high degree of concordance (Kappa index = 0.78) with the proportion of concordance of surgical and orthodontic cases being 0.78 and 0.81, respectively, with a degree of confidence of 95 per cent.

163 NEW MAXILLARY LANDMARKS IN COMPUTER TOMOGRAPHIC SCANS: METHODOLOGY AND REPRODUCIBILITY

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AIM: As the computer tomogram (CT) has an increasing impact on diagnostic decisions, the aim of this study was to establish new landmarks to evaluate selected dimensions in the maxillary complex using a morphometric method based on CT scanning.
SUBJECTS AND METHOD: Ten adults who, regardless of their facial and skeletal morphology, were placed face down with the neck hyperextended. The scanning plane was 90 degrees to the hard palate, resulting in a coronal plane orientation. The table feed was set at 1.0 mm. The evaluation was based on two slices. Eighteen landmarks and 11 parameters were determined on the two reference planes, i.e. the anterior slice that showed the entire canine and the posterior slice that showed the entire molar. Statistical analysis of the independent inter- and intra-observer relationship and of the digitizing process was performed. Using acetate paper the landmarks were identified. Specific dimensions such as width of the nasal cavity and alveolar crest were measured and calculated using a digitizer in conjunction with a defined computer cephalometric analysis program
RESULTS AND DISCUSSION: Landmark identification did not exhibit any statistically significant difference between the measurements. The introduced landmarks for the maxillary structures in the CT show a high reproducibility and identification and are a useful tool in orthodontic diagnosis and treatment planning. A prospective study concerning rapid maxillary expansion is commencing.

164 THE DETECTION OF ENAMEL ETCH ON BUCCAL AND LINGUAL PREMOLAR SURFACES USING QUANTITATIVE LIGHT-INDUCED FLUORESCENCE

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AIM: To determine if quantitative light-induced fluorescence (QLF) could detect clinical levels of acid-etching on human premolar surfaces and determine differences between buccal and lingual surfaces.
MATERIALS AND METHOD: Fifteen extracted human maxillary first premolars were selected following an examination to determine that they were free from caries, restoration, extraction damage, or other enamel malformation. Each tooth was gently pumiced and abraded with wet and dry paper on both the buccal and lingual surfaces. Transparent nail varnish was placed on each surface leaving an exposed enamel window. Baseline QLF images were taken of each surface. Each tooth surface (buccal and lingual) was then subjected to 20 seconds of acid etch using a gel formulation of 37 per cent phosphoric acid. The teeth were then gently washed and dried using compressed air. QLF images were taken and the process repeated at 40 and 60 seconds exposure to etch. The QLF images were analysed and the ΔF values at the 10 per cent threshold reported.
RESULTS: Baseline ΔF was: buccal 0.0 (± 0.34), lingual 0.0 (± 0.24), after 20 seconds this had increased to buccal 11 (± 3.05), lingual 11.76 (± 3.74); at 40 seconds buccal 18.99

(±5.00), lingual 20.98 (±5.58); and at 60 seconds buccal 24.18 (±5.77), lingual 26.87 (±5.33). Statistical differences were detected between buccal and lingual surfaces at 40 and 60 second exposures.
CONCLUSION: This initial pilot study has demonstrated the potential for QLF to detect and quantify acid-etch of human enamel. Further work correlating this to bond strength may determine optimal etch times for orthodontic attachments. Lingual surfaces appear to be more susceptible to etching at longer exposures, although at clinical levels this may not be relevant.

165 A COMPARATIVE STUDY OF A LOW FRICTION ELASTIC AND CONVENTIONAL LIGATURES

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AIM: To compare, *in vitro*, the friction caused by a new design of elastomeric ligature (low friction elastomeric ligature; LFEL), with conventional elastomeric and metallic ligatures.
MATERIALS AND METHOD: Stainless steel brackets with a slot of 0.018 × 0.022 inch; 0.016 × 0.022 inch stainless steel rectangular archwire in bars; 0.120 inch elastomeric ligatures; 0.010 inch preformed metallic ligatures, prototypes of LFEL. The LFEL has two parts: (1) a solid central body placed over the slot that does not allow contact between it and the arch and avoids the arch getting in the way as it covers the slot; and (2) a ligature ring that goes under the wings as in a conventional ligature. An MTS Bionix essay machine was used to determine the dynamic friction forces delivered by the different types of ligature when the archwire was slid onto the slot of the bracket.
RESULTS AND CONCLUSION: Friction was much lower (80 per cent less) when the LFEL were used in comparison with the other ligatures. The use of LFEL seems to be indicated in sliding mechanics.

166 FACTORS REGULATING MANDIBULAR CONDYLAR GROWTH

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AIM: To identify factors regulating proliferation, differentiation, and maturation of cells and tissues in the condyles and to correlate these factors to condylar growth.
MATERIALS AND METHODS: One hundred and forty-five, 35-day-old, Sprague–Dawley rats were used. The expression of a series of factors was identified using immunostaining and *in situ* hybridization. The rats were sacrificed on days 38, 42, 49, 56, and 65.
RESULTS: Sox 9 was expressed by cells in the proliferative layer. Type I CbFa1 was expressed by chondrocytes later on day 56. Type X collagen was expressed only by hypertrophic chondroctyes and its expression preceded the onset of endochondral ossification. VEGF was expressed by lower hypertrophic chondrocytes and its maximum level of expression preceded the maximum level of bone formation. Type II CbFa1 was localized in the osteoclasts and osteoblasts in the mineralization front.
CONCLUSIONS: Condylar growth is regulated by a concert of factors that are intrinsically synthesized by cells in the condyles.

167 PROFILE CHANGES AFTER UPPER INCISOR RETRACTION IN CLASS II DIVISION 1 PATIENTS, WITH AND WITHOUT LIP SEAL—AN IMPLANT STUDY

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AIM: To evaluate soft tissue changes after upper incisor retraction in Class II division 1 patients with and without a lip seal, following orthodontic treatment and maxillary first premolar extractions.
MATERIAL AND METHOD: Forty-eight lateral head radiographs were used. Partial and total superimposition methods were applied, using metallic implants and cranial base references. The sample was divided into three groups: Group I, without incisor retraction; Group II, incisor retraction in subjects with a lip seal; Group III, incisor retraction in patients without a lip seal.
RESULTS: Upper incisor retraction was followed by upper lip retraction in the sealed and unsealed lip groups by 1:0.75 and 1:0.70 mean ratios, respectively, considering movement of the cervical incisor point. Rest lip posture before treatment affected lower lip response, moving significantly up in the unsealed group after upper incisor retraction. Stomion point showed greater posterior movement in the unsealed group. The upper lip (Ls) prediction equation showed a high predictive capacity depending on the upper cervical point, representing 63.6 and 68.5 per cent determination coefficients in the sealed and unsealed lip groups, respectively. Es and Ls vertical and A' horizontal movement prediction equations were equally good. The labial and nasolabial angles showed low predictable changes; however, they clearly tended to open after incisor retraction.
CONCLUSIONS: Partial superimpositions are useful to evaluate some soft tissue treatment changes hidden by growth.

168 TEMPOROMANDIBULAR DYSFUNCTION AND CONDYLAR LESIONS IN CHILDREN AND ADOLESCENTS WITH JUVENILE IDIOPATHIC ARTHRITIS

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AIM: To investigate the prevalence of symptoms and signs of temporomandibular dysfunction (TMD) in children and

adolescents with juvenile idiopathic arthritis (JIA), and to study whether radiographic condylar lesions are related to local corticosteroid treatment of the temporomandibular joints (TMJs).
SUBJECTS AND METHODS: Twenty-three girls and three boys (mean age 11.6 years; range 5–22 years) with JIA referred for orthodontic consultation between 1998 and 2001. Signs and symptoms of TMD and mandibular movement capacity were recorded using the method of Helkimo (1974) as modified by Ettala-Ylitalo (1987). Morphological alterations of the TMJs were recorded from panoramic radiographs according to the modified method of Rohlin-Petterson (1989).
RESULTS: Approximately 40 per cent of the subjects complained of TMD symptoms, e.g. pain, crepitation, fatigue of the jaw, and impaired mandibular mobility. Jaw deviation on opening was found in 80 per cent of the subjects while less than one-third suffered from palpatory tenderness of the muscles, and one-quarter had asymmetry in lateral jaw movements. Arthritic degenerative involvement of the condylar head was found in 69 per cent. Eight subjects had received a local corticosteroid injection in the TMJs. No correlation was found between morphological alterations and local treatment (r = 0.03 and –0.12 for right and left condyles, respectively).
CONCLUSIONS: Even if children with JIA do not complain of TMD symptoms, single signs of dysfunction and condylar lesions on panoramic radiographs are found in almost all of them. Local corticosteroid treatment of the TMJs does not seem to be related to condylar morphological alterations. These preliminary results indicate that it is important to monitor regularly the orofacial functions and radiological status of the condyles in patients with JIA. Further studies are needed to evaluate the effect of local corticosteroid treatment upon the TMJs.

169 COMPARISON OF A LIGHT-CURING DENTURE AND COMPOSITE RESINS FOR BRACKET BONDING

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AIMS: To compare, *in vitro*, the shear bond strength of a modified visible-light curing (VLC) denture based resin made by mixing Triad® VLC Provisional Material and Heliobond® monomer, with two standard composite resins, Concise® and Transbond® XT, for the bonding of stainless steel brackets; to evaluate, *in vivo*, its failure rate with that of Transbond XT using a split-mouth design.
MATERIALS AND METHODS: *In vitro* study: 115 freshly extracted bovine mandibular incisors were randomly assigned to one of five groups consisting of 23 specimens each. Three groups were bonded with the Triad/Heliobond mixture and light-cured for 20, 30, and 40 seconds, respectively; the other two were bonded with the standard adhesives. All samples were stored in water at room temperature for 24 hours and subsequently tested in a shear mode on an Instron universal testing machine. *In vivo* study: 35 consecutive patients with fixed appliances were followed for a 12-month period; 335 brackets were bonded with the Triad/Heliobond mixture, 330 with Transbond.
RESULTS: The shear bond strength of Triad was significantly lower than that of Transbond and Concise ($P < 0.001$). Concise produced the highest mean bond strength with 23.5 ± 5.7 MPa followed by Transbond (17.0 ± 4.6 MPa). The bond strengths of Triad (40s), Triad (30s), and Triad (20s) were 13.6 ± 3.3, 11.4 ± 3.4, and 5.2 ± 3.6 MPa, respectively. The overall failure rate of Triad (4.3 per cent) was not significantly different from that of Transbond (3.6 per cent). No significant differences in the failure rates of the upper and lower arch within each material or between the two materials were found ($P > 0.05$). Transbond showed a significantly higher failure rate ($P < 0.05$) in the anterior (4.8 per cent) than in the posterior teeth (1.6 per cent).
CONCLUSIONS: Although Triad resin exhibited bond strength inferior to traditional bonding systems, *in vitro*, its clinical performance was found to be comparable.

170 OCCLUSAL AND SKELETAL EFFECTS OF A MANDIBULAR PROTRUSIVE APPLIANCE IN THE TREATMENT OF OBSTRUCTIVE SLEEP APNOEA

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AIM: To investigate the long-term skeletal and occlusal side-effects of a nocturnally worn mandibular protrusive appliance (MPA) in adult patients treated for mild obstructive sleep apnoea (OSA).
SUBJECTS AND METHODS: Dental casts and lateral cephalograms of 34 patients (mean age 52.9 years, SD 9.6, range 27.1–64.6 years) were evaluated before initiating treatment with an oral protrusive appliance, and after at least 24 months of MPA therapy (mean 33.4 months, range 24.1–144.3 months, SD 5.1). The patients wore the MPA 6–8 hours nightly for more than 5 days per week. Data were statistically assessed with a Wilcoxon test.
RESULTS: Odontometric analysis revealed a statistically significant alteration in the occlusion. There was a reduced overjet ($P < 0.05$) and overbite ($P < 0.05$), a lateral open bite ($P < 0.001$), and a more mesial antero-posterior position of the first molars ($P < 0.001$). Cephalometric analysis verified the change in upper and lower incisor inclination. No skeletal changes in the position of the mandible were found. Subjectively only two patients recognized occlusal changes in the follow-up investigation.
CONCLUSION: In addition to control polysomnographic examination, regular dental follow-up visits are mandatory when life-long treatment with an MPA is being considered in patients with OSA.

171 *IN VITRO* ASSESSMENT OF DIFFERENT POLYETHYLENE FIBRES EMBEDDED IN COMPOSITE

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AIM: Composite resin retainers reinforced with plasma-treated woven polyethylene ribbons have recently been introduced in orthodontics. The aim of this *in vitro* study was to compare the mechanical material properties of different polyethylene ribbons embedded in resin for orthodontic application.
MATERIAL AND METHODS: The polyethylene fibres (Ribbond™, Connect™, and Splint-It™) embedded in composite (Concise™ and Heliosit®) were investigated in a three-point bending test to failure, a tensile strength test, and a dynamic and thermo-dynamic loading test with repeated measurements. The influence of the fibres' position within the resin was examined. Scanning electron microscopy was carried out at the end of mechanical testing.
RESULTS: The fibres embedded in Concise™ did not influence the apparent modulus of elasticity and flexural strength but did increase both variables using Heliosit®. The fibre significantly increased tension strength and modulus of elasticity of the test block independently of its dimension. The Splint-It™ significantly increased its flexural strength by 35 per cent, Ribbond™ by 70 per cent, and Connect™ by 177 per cent compared with the controls. Ribbond™ did not influence the apparent modulus of elasticity, as was found with Splint-It™ and Connect™ ($P < 0.01$), which increased these variables. Tension strength was significantly increased from Splint-It™ to Ribbond™, and Connect™. In the dynamic loading test the Connect™ fibre was significantly superior to Ribbond™ and Splint-It™. The thermo-dynamic loading test revealed no changes in catastrophic failure behaviour compared with the dynamic loading test under constant temperature.
CONCLUSION: Polyethylene fibres embedded in low filled composite do change their mechanical properties. The different fibre/matrix design led to significantly different physical characteristics.

172 THE ROLE OF ALVEOLAR GROWTH IN THE DEVELOPMENT OF A NORMAL FACIAL PATTERN

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AIM: The alveolar structure is the functional component of the jaws. It not only supports the teeth but also participates in dynamics of occlusion via the teeth. The alveolar structure also has a compensatory role in the maintenance of the occlusal relationship between the jaws. Finally, it is clear that treatment of skeletal deviations is generally based on the purposeful alteration of dentoalveolar development. In this study growth changes of the dentoalveolar structures were examined in subjects with a normal facial pattern in early and late growth periods.
SUBJECTS AND METHOD: Sixty-two subjects, who had a normal facial pattern. The study groups were created according to hand–wrist radiograms. The first (early) group comprised 30 subjects whose skeletal development was between PP2-S maturation stages. The second (late) group, whose skeletal development was between PP3U-RU maturation stages, comprised 32 subjects. Cephalometric and hand–wrist films were obtained at the start and end of the observation periods. Skeletal and dentoalveolar measurements and the ratios between them were assessed in both groups. Intragroup differences in the measurements and ratios were examined by a paired *t*-test and intergroup differences by a Student's *t*-test.
RESULTS: All alveolar heights showed a substantial increase throughout the early growth period. In the late period, the increase in upper anterior alveolar height was not significant. It was found that the increase in alveolar heights differed between the groups. Total alveolar height ratio (TAAH/TPAH) remained stable in the earlier period, whilst in the late period a small increase was observed.
CONCLUSION: Alveolar growth is an important issue in the development of a normal facial pattern.

173 WHAT MAKES THE DIFFERENCE BETWEEN FAILURE AND SUCCESS IN VAN BEEK ACTIVATOR TREATMENT?

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AIM: To assess possible differences in effective temporomandibular joint (TMJ) and chin changes when comparing Class II subjects with successful and unsuccessful overjet correction during van Beek activator treatment.
SUBJECTS AND METHOD: Twenty consecutive normodivergent male Class II division 1 patients treated with a van Beek activator. Due to insufficient co-operation (assessed after 2 months of treatment), four subjects were excluded from the investigation. Lateral headfilms were taken 6 months prior to treatment, at the start, after 6 and 12 months of treatment, and after a 24-month follow-up period. The subjects were divided into a successful ($n = 7$) and unsuccessful ($n = 9$) group according to the amount of overjet reduction achieved. An overjet reduction larger than 4 mm was considered successful and a reduction smaller than 2 mm as unsuccessful. The headfilms were evaluated by means of a modified method of Creekmore (1967) using an arbitrary condylar point (Co). Maxillary and chin position changes were measured using A and Pogonion (Pg) points as landmarks.
RESULTS: The average overjet reduction during treatment amounted to 5.8 mm in the successful and 1.4 mm in the unsuccessful group. In the pre-treatment period the unsuccessful group exhibited 1.8 mm more inferior chin changes compared with the successful group ($P < 0.01$). Except for

overjet reduction, no significant group differences were found for any of the variables during all observation periods during and after treatment. However, there was a tendency towards more superior Co changes (+1.3 mm), more inferior Pg changes (+0.5 mm), more anterior point A changes (+1.1 mm), and less posterior Co changes (–1.5 mm) in the unsuccessful group. The anterior Pg changes, however, were identical in both groups.
CONCLUSION: As no difference in sagittal chin changes existed between the groups, the reason for failure of van Beek Activator treatment seems to be larger maxillary forward growth and less Class II corrective dental changes.

Creekmore T D 1967 Inhibition or stimulation of the vertical growth of the facial complex, its significance to treatment. Angle Orthodontist 37: 285–297

174 INTERRELATIONSHIP BETWEEN THE AMOUNT OF BITE JUMPING AND EFFECTIVE TEMPOROMANDIBULAR JOINT AND CHIN CHANGES IN HERBST TREATMENT

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AIM: To analyse the effective temporomandibular (TMJ) and chin changes in relation to the amount of bite jumping and to assess a possible interdependence between them.
SUBJECTS AND METHOD: Lateral headfilms of 40 Class II division 1 patients (20 females, 20 males) treated with the Herbst appliance. The radiographs were taken before, at the start (with the appliance in place), and after treatment. The radiographs were evaluated by means of a modified method of Creekmore (1967) using an arbitrary condylar point (Co). Additionally the amount of sagittal and vertical bite jumping was assessed.
RESULTS: At the start the mandible was on average jumped 7.1 mm anteriorly and 5.6 mm inferiorly. Considering the entire observation period from before to after treatment, point Co moved on average 3 mm posteriorly and 5 mm superiorly, while the chin changed its position 3 mm anteriorly and 5 mm inferiorly. Males showed significantly ($P < 0.01$) larger vertical condylar and sagittal chin changes than females. No significant interrelationship was found between point Co changes and the amount of bite jumping. In males the sagittal chin changes were inversely proportional to the amount of vertical ($r = –0.63$**) and directly proportional to the amount of sagittal ($r = 0.36$ n.s.) bite jumping. For vertical chin changes in males the opposite was true ($P < 0.01$). In females the sagittal chin changes were directly proportional to the amount of sagittal bite jumping ($r = 0.50$*), while no interrelationship was found for vertical bite jumping. The amount of chin change relative to the amount of initial bite jumping was 60 per cent in the sagittal and 103 per cent in the vertical direction for males, and 26 and 97 per cent, respectively, for females.
CONCLUSION: Both sagittal and vertical chin changes are interrelated to the amount of bite jumping. However, vertical changes seem to be more predictable than sagittal changes.

175 DENTAL ANOMALIES IN SIZE AND POSITION

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AIM: To evaluate clinically and statistically the association between the small size of maxillary lateral incisors (SLI) and palatal displacement of maxillary canines (PDC) in order to derive indications for interceptive orthodontics.
SUBJECTS AND METHODS: A sample of 6285 subjects (age range 7–17 years) was examined. Two hundred and fifteen subjects were excluded due to the presence of complex craniofacial malformations, and a second group of 323 subjects due to incomplete records. The remaining 5747 subjects were then randomly divided into two groups: a test group (4747 subjects) and a control group (1000 subjects). In the first group two subgroups of 100 subjects each were selected according to the presence of SLI and PDC, respectively. The prevalence rates for the two dental anomalies were recorded in the control group. The diagnosis was performed on dental casts and panoramic radiographs.
RESULTS: The prevalence rate for PDC in the group with SLI was 34 per cent and SLI in the PDC group 20 per cent. The reference prevalence rates for SLI and PDC in the control group were 4.7 and 5.2 per cent, respectively. Chi-square tests revealed significant differences between the test and control groups.
CONCLUSION: There was a significant reciprocal association between PDC and SLI. Early diagnosis of a reduction in the size of maxillary lateral incisors may be helpful in preventing impaction and/or displacement of the maxillary canines, by timely extraction of the primary canines.

176 NICKEL AND COBALT HYPERSENSITIVITY REACTION BEFORE AND AFTER ORTHODONTIC THERAPY

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AIM: To cross-sectionally determine the prevalence of nickel hypersensitivity reaction before and after orthodontic treatment with conventional stainless steel brackets and wires.
SUBJECTS AND METHOD: Eighty-two patients (55 females, 27 males). Patch testing and a questionnaire were used to evaluate hypersensitivity to nickel and cobalt, which are major components of orthodontic appliances. Statistical analysis was carried out with Fisher's exact X^2 (2×2) test.
RESULTS: The prevalence of nickel allergy was higher in females than males (14.55 per cent in females, 0 per cent in males). The prevalence of cobalt allergy was 9.76 per cent (7.27 per cent in females, 14.81 per cent in males) Orthodontic

treatment with conventional stainless steel alloys does not affect the gingival and oral health of patients. Neither a previous family history of allergy nor the use of metallic objects in contact with the skin characterized the nickel and cobalt hypersensitive subject. This suggests that orthodontic therapy with conventional stainless steel appliances does not initiate or aggravate a nickel hypersensitivity reaction.
CONCLUSION: There was no association between before or after treatment and hypersensitivity reaction to nickel and cobalt.

177 HEAD POSTURE AND UPPER AIRWAY MORPHOLOGY IN ADULT MALES AND FEMALES

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AIM: To investigate the morphological differences of the upper airway in adult male and females on lateral cephalometric radiographs.
MATERIAL AND METHOD: Seventy-six lateral cephalometric head films of 38 adult males and 38 adult females taken in the natural head position (NHP) were evaluated. The individuals were expected to be over 18 years of age, to have parents of Turkish origin, to have an acceptable face structure, ideal dental occlusion and a skeletal Class I pattern, to have no visual and hearing disorders, and to have all teeth present except for third molars. The subjects had not undergone orthodontic treatment and/or orthodontic surgery, had no burns, injuries, cicatrix tissue on the head and neck regions, and did not have any breathing or swallowing disorders. In order to determine NHP, the subjects were requested to stand at rest in a relaxed manner, namely the self-balance position; this position was transferred to the cephalostat by means of a fluid level device. The effects of sex on upper airway morphology were investigated by means of a Student's *t*-test using SPSS 7.5 for Windows.
RESULTS AND CONCLUSION: The measurements used in the determination of NHP were not affected by sex. The linear measurements regarding the position of the bony structures MP–AH, AH–AH1, C3ia–AH, Ba–C3ia, the soft tissues PNS–P, MPT, VAL, TGL, TGH, the tongue, the soft palate, and the oropharynx areas were statistically significant ($P < 0.001$) with respect to sex. NHP was not affected by sex differences. It was found that the soft palate and tongue are longer and thicker in males than females. The area of the tongue, the soft palate, and the oropharynx are wider in males than females.

178 ESTABLISHMENT OF CERVICAL VERTEBRAL BONE AGE AND CLINICAL IMPLICATIONS

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AIM: To establish cervical vertebral bone age as a new index for objectively evaluating skeletal maturation on cephalometric radiographs. Using morphological changes in cervical vertebral bodies in puberty, for evaluation of skeletal maturation, is important in orthodontic treatment.
SUBJECTS AND METHOD: The cervical vertebral bodies of 176 females and 128 males (7.0–15.9 years old) were measured on cephalometric radiographs, and a regression formula was determined to obtain cervical vertebral bone age. Furthermore, a programme to automatically calculate cervical vertebral bone age by plotting points on cervical vertebral bodies was developed.
RESULTS: 1. A regression formula was determined to obtain cervical vertebral bone age based on ratios of measurements of C3 and C4 in each sex. 2. The correlation coefficient for the relationship between cervical vertebral bone age and bone age using the Tanner–Whitehouse 2 (TW2) method was significantly ($P < 0.05$) higher than that for the relationship between cervical vertebral bone age and chronological age.
CONCLUSIONS: Cervical vertebral bone age reflects skeletal maturity as it approximates bone age assessed by the TW2 method on hand–wrist radiographs, which is considered to be the most reliable method for measuring the degree of maturity. Using cervical vertebral bone age along with other cephalometric analyses, it becomes easier to evaluate skeletal maturity in a detailed and objective manner without hand–wrist radiographs.

179 AN ELECTROMYOGRAPHIC AND ECHOGRAPHIC STUDY OF PERIORAL MUSCLES IN ADULTS

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AIM: To verify the presence of a correlation between muscular activity and lip thickness with overbite values.
SUBJECTS AND METHOD: Fifty subjects between 20 and 31 years of age were examined regarding the activity and thickness of the perioral musculature using electromyographic and echographic techniques to compare the obtained values with the entity of overbite.
RESULTS AND DISCUSSION: A correlation was found between activity and lip thickness and the entity with overbite was confirmed.

180 VARIABILITY OF SPATIAL ACTIVATION PATTERNS IN CHEWING MUSCLES—THE INDIVIDUALITY OF MOTOR STRATEGIES

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AIM: Spatial activation patterns of the chewing muscles depend on the direction and force of mandibular movements. The aim of this investigation was to characterize the intra- and inter-individual variability of the electromyographic (EMG) distribution patterns in humans.

SUBJECTS AND METHOD: Fifteen healthy male volunteers, 21–28 years of age. During different motor tasks a 16-channel surface EMG was recorded from the masseter and temporal muscles by means of 16-electrode grids. The subjects, who sat in a chair with the head in an upright position, were asked to compensate for forces that affected the mandible from frontal and lateral directions without leaving the postural position. Moreover they should bite with constant force and chew hazelnuts. EMG was quantified by power spectral analysis. After linear interpolation of the spectral EMG power (16–497 Hz) between the electrodes, the topographically orientated EMG distribution could be demonstrated by EMG maps (EMG interference mapping). The variability of topographic EMG patterns was evaluated by median and quartiles of the single electrode EMG values as well as the global dissimilarity and the Spearman rank-order correlation coefficient of the EMG maps (matrix of spectral EMG power values).
RESULTS: Depending on the motor task, the masseter as well as the temporal muscles showed a different topographical distribution of spectral EMG characteristics. The activated areas corresponded with the expected force vector. For the examined motor tasks, a relatively low intra-individual variability was found. The inter-individual variability was higher. During chewing, biting, and mediotrusion there was a higher inter-individual similarity of the topographic EMG patterns than during laterotrusion and retraction of the mandible.
CONCLUSIONS: The topographical different activation patterns confirm the hypothesis of functionally different compartments within the chewing muscles. Obviously spatially defined groups of motor units are activated during different automated movements. Motor tasks, which are seldom practised, show more various realizations with respect to activation patterns.

181 PREDICTION OF DENTAL CROWDING DURING THE MIXED DENTITION

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AIM: Crowding of the dental arches is the second most common reason to seek orthodontic treatment in populations with available orthodontic care. Data on tooth size used to estimate developing crowding during craniofacial growth are at least 50 years old and no longer applicable (Stull, 1998). The aim of this study was to develop a best-fit model to test the hypothesis that the size of the teeth erupting during the late mixed dentition can be predicted using the size of permanent teeth erupted during the early stage of the mixed dentition.
SUBJECTS AND METHODS: One hundred girls and 100 boys were included, the criteria being excellent quality of hard stone casts, presence of all permanent I_1, I_2, C, P_1, P_2, M_1, and no approximal caries or fillings. Mesiodistal crown widths (MDW) of permanent teeth were measured with a digital sliding calliper in 0.01 mm. Intra-examiner consistency was high. ICC values based on triple measurements of 40 cases varied from 0.86 to 0.98 with a 95 per cent confidence interval.
RESULTS: MDWs of all permanent teeth were clearly smaller in girls than the corresponding dimensions in boys ($P < 0.05$, ANOVA). The best fitted regression models showed that the sum of the left and right mandibular I_1, I_2, M_1, gave the highest estimate on both sides in both arches for boys, with R^2 from 50 to 66 per cent. For girls, the sum of all I_1, I_2, M_1 was needed to provide the best prediction for the left and right mandibular C, P_1, P_2, with R^2 53 and 60 per cent, respectively. For the maxillary C, P_1, P_2 on both sides, the regression model based on the sum of MDW of all maxillary I_1, I_2, M_1 gave the best estimate, with R^2 49 and 52 per cent.
CONCLUSIONS: The size of early erupted permanent teeth provides a useful method to estimate developing dental crowding, but different regression models are needed for the maxilla and mandible, separately for boys and girls.

182 EFFECT OF LIGHT TIP DISTANCE ON THE BOND STRENGTH OF A COMPOSITE AND GLASS-IONOMER ADHESIVE RESIN

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AIM: To evaluate the effect of the distance of the light tip from the bracket base on the shear bond strengths of orthodontic brackets bonded with either a composite resin or a resin-modified glass ionomer and cured with two different light-curing units: a conventional halogen light and a xenon arc light.
MATERIALS AND METHODS: One hundred and eighty freshly extracted bovine permanent mandibular incisors were randomly divided into one of 12 groups, with each group consisting of 15 specimens. One hundred and eight stainless steel brackets (Victory, Unitek/3M) were evaluated. Ninety were bonded with a composite resin (Transbond XT, Unitek/3M), and the remaining 90 with a resin-modified glass ionomer (Fuji Ortho LC, GC America). For each type of adhesive, two different light-curing units were tested: a halogen light (Astralis, Ivoclar-Vivadent), used for 10 seconds, and a xenon arc light (PAC, A. D. Technologies), for 4 seconds. The polymerization of both adhesives was achieved by using the tips of each light source at three different distances from the bracket base: 0, 3, and 6 mm. After bonding, all samples were stored in distilled water for 24 hours and subsequently tested in a shear mode with an Erichsen–Wuppertal machine. Statistical analysis (ANOVA, Scheffé's test) was performed.
RESULTS: By increasing the distance of the tip from the bracket base from 0 to 6 mm, the mean shear bond strength of both adhesives was significantly greater ($P < 0.05$) when using the PAC light. Conversely, the distance of the light tip

from the bracket did not have any significant effect ($P > 0.05$) on the mean bond strength of both adhesives when using Astralis. Transbond XT produced significantly higher bond strengths than those of Fuji Ortho LC, independently of the type of light source and distance of the tip.
CONCLUSIONS: The bond strength of brackets cured with the xenon arc light can be significantly augmented by increasing the distance of the light tip from the bracket base.

183 CHONDROCYTE DIFFERENTIATION AND CHONDROID FORMATION IN THE GLENOID FOSSA DURING FORWARD MANDIBULAR POSITIONING

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AIM: To quantitatively assess the temporal expression of SOX9 and type II collagen in the glenoid fossa during natural growth and forward mandibular positioning.
MATERIALS AND METHODS: Eighty female 35-day-old Sprague–Dawley rats were randomly divided into eight groups with five rats in each experimental and control group. The experimental group was fitted with mandibular advancement appliances. The rats were sacrificed on days 1, 3, 5, 7, 9, 11, 14, and 17. Sections were cut through the glenoid fossa at the sagittal plane. Immunohistochemistry was performed to identify SOX9 and type II collagen. The expression level was measured quantitatively by the Leica QWin image analysis system.
RESULTS: Forward mandibular positioning led to a significant increase in the expression of SOX9 and type II collagen at all time points in the anterior, middle, and posterior regions when compared with the expression during natural growth. The maximum levels of expression were found consistently on experimental day 3 with the percentage increase in the expression of SOX9 and type II collagen measured as 71 and 55 per cent, respectively. Furthermore, the level of expression of SOX9 and type II collagen was significantly higher in the posterior region than the middle and anterior regions.
CONCLUSIONS: Biomechanical forces induced by forward mandibular positioning solicit molecular and cellular changes that lead to upregulated expression of SOX9 and type II collagen in the glenoid fossa.
Supported by CRCG grant 10203770.22311.08003.323.01 from the University of Hong Kong.

184 THE EFFECT OF THE OCCLUSAL PLANE ON ANTERIOR FACE HEIGHT IN THE MANDIBULAR SET-BACK PROCEDURE

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AIM: To evaluate the effect of the occlusal plane on anterior face height (AFH) change after mandibular set-back.
SUBJECTS AND METHOD: Twenty-five adults (19 females, six males) aged 19–24 years with mandibular prognathism were selected from private practice for mandibular set-back procedure. Study models, photographs, and radiographs were obtained. After banding and bonding, orthodontic decompensation was carried out and the required intra- and inter-arch relationship for orthognathic surgery were achieved. Pre- and post-surgery cephalometric data were evaluated.
RESULTS: There was an inverse relationship between face height and occlusal plane angle Occl–SN < 20 – AFH ($P < 0.001$) Occl–SN > 20 – AFH decrease ($P < 0.001$).
CONCLUSION: The relationship between the occlusal plane angle and AFH change seems to have an inverse relationship in patients scheduled for a mandibular set-back procedure. The occlusal plane angle should be considered before any surgical approach especially in subjects with a normal vertical dimension.

185 VEGF EXPRESSION AND BONE FORMATION IN THE GLENOID FOSSA DURING STEPWISE MANDIBULAR ADVANCEMENT

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AIM: To assess the amount of VEGF expression and to correlate this to new bone formation in the glenoid fossa during stepwise mandibular protrusion.
MATERIALS AND METHODS: Two hundred and fifty female 35-day-old Sprague–Dawley rats were randomly divided into 10 groups, each including five control and 20 experimental rats. Within each group, 10 experimental rats were fitted with functional appliances with a one-step advancement of 3.5 mm and another 10 with stepwise appliances with an initial advancement of 2 mm and subsequent increase to 3.5 mm on day 30. The rats were sacrificed after 3, 7, 14, 21, 30, 33, 37, 44, 51, and 60 days, respectively. Sections of 7 μm were cut through the glenoid fossa sagittally and stained with anti-VEGF antibody. VEGF expression in the posterior glenoid fossa was evaluated by a computer-assisted image analysing system.
RESULTS: Both VEGF expression and new bone formation were higher in the experimental rats than in the controls. In the one-step experimental group, VEGF expression reached a peak on day 14 and then fell progressively. During stepwise advancement, VEGF expression was lower than that of the one-step group during the initial period of the experiment, but the second advancement solicited a second peak on day 44. Both VEGF expression and new bone formation remained significantly higher than that in the one-step animals towards the end of the experiment.
CONCLUSIONS: Stepwise advancement of the mandible delivers mechanical stimuli that produce a series of tissue responses leading to increased vascularization and subsequent bone formation.
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186 DENTOALVEOLAR CHARACTERISTICS IN CHILDREN WITH JUVENILE IDIOPATHIC ARTHRITIS

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AIM: To study dentoalveolar and occlusal characteristics and treatment need in children with Juvenile Idiopathic Arthritis (JIA).
MATERIALS AND METHOD: Study casts from 66 children (27 boys, 39 girls) with JIA being treated in the Department of Pediatrics were evaluated. Thirty-three children showed some form of condylar destruction. Angle's classification, overjet, overbite, crowding, and ectopic teeth were also registered. All dental casts were scanned and digitized and model analysis was performed by means of the cephalometric software (Viewbox) adjusted to the needs of the present study. Twenty-six variables were evaluated. Corresponding patient groups were formed according to sex and condylar affection. In addition, the study models were evaluated using the Index of Complexity, Outcome and Need (ICON) in order to estimate treatment need. Statistical analysis was performed using the statistical software package SPSS (level of significance $P \leq 0.05$). In order to evaluate the method error, the whole evaluation was repeated after 2 weeks in 30 randomly selected cases.
RESULTS: The prevalence of Class II division 1 malocclusions (33.3 per cent) in this group was high. Boys showed significantly greater mandibular and maxillary widths and lengths compared with girls. No differences were observed between the groups with and without condylar affection, although the group with bilateral condylar affection presented a higher irregularity index of the lower anterior teeth and a significantly reduced lower arch length. According to the ICON, 57.5 per cent of the children with JIA needed orthodontic treatment.
CONCLUSIONS: Children with JIA present a high prevalence of Class II division 1 malocclusions and more than 50 per cent require orthodontic treatment.

187 CONTROL OF CARIES INDUCING BACTERIA IN ORTHODONTICALLY TREATED PATIENTS

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AIM: To assess the effectiveness of cleaning teeth and appliances with dental floss and brushes designed for orthodontic patients in the reduction of caries inducing bacteria.
SUBJECTS AND METHODS: Thirty patients, 10–13 years of age. The level of *Streptococcus mutans* and *Lactobacillus acidophilus* was determined using the colour–reaction–time test. Dental plaque levels were determined with the Plaque Index (Silness and Löe). The patients were instructed in cleaning their teeth according to Fone's method and were provided with a set containing dental floss and brushes designed for orthodontic patients. Bacteria and plaque levels were determined at the first inspection and one month after instruction.
RESULTS: The percentage of patients with *Streptococcus mutans* decreased from 73 to 70 per cent after cleaning instruction. Cleaning teeth and appliances with dental floss and specially designed brushes did not result in a reduction in the number of *Lactobacillus acidophilus*-infected patients (100 per cent). However, there was a reduction in the Plaque Index from 0.66 to 0.28.
CONCLUSION: Hygiene procedures with standard tools such as dental floss and brushes for orthodontic patients do not result in a reduction in the level of *Streptococcus mutans* and *Lactobacillus acidophilus*, but limit proliferation of plaque. The search for new and convenient methods that could be used for elimination of bacterial infections is still an important challenge.

188 CORRELATION BETWEEN ORAL HYGIENE, DENTAL PLAQUE AND GINGIVAL INFLAMMATION IN INDIVIDUALS WITH CROWDING

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AIM: To evaluate the role of dental crowding as an aetiological factor for clinical determination of periodontal disease. The degree of correlation between oral hygiene indices (OHI), dental plaque (IDP), and gingival inflammation (IGI) was assessed.
SUBJECTS AND METHODS: One hundred individuals with crowding, aged 10–14 years, who were examined gnathometrically, clinically, and radiographically. Stain tests were performed and the results were processed using an application for statistical automatization (Statistica 95 for Windows), applying Student's *t*-test and Spearman's rank correlation.
RESULTS: Correlation analysis showed that gingival bleeding, representing a major symptom for periodontal involvement, was related to poorer oral hygiene among individuals with crowding ($R = 0.74$). There was a highly significant correlation between the mean values for IDP and OHI ($R = 0.93$), indicating that oral hygiene plays a significant role in dental plaque accumulation. Bacterial plaque was found to have a relationship with IDI in subjects with crowding ($R = 0.77$).
CONCLUSION: Poor oral hygiene is related to crowding, which results in raised dental plaque accumulation and compromised gingiva and periodontal health.

189 BASAL AND DENTAL ARCH WIDTH IN KOREAN SUBJECTS WITH SKELETAL CLASS III MALOCCLUSIONS

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AIM: (1) To compare the dental and basal arch width of hyperdivergent subjects with those of a neutral Class III

malocclusion group based on the vertical patterns; (2) to compare the dental and basal arch widths of the Class III neutral group with those of the normal occlusion group based on sagittal patterns.
MATERIAL AND METHODS: One hundred and eighteen pairs of study casts, divided into three groups: 37 Class III hyperdivergent subjects (18 males, 19 females, SN–Mn plane angle >39.5°), 40 Class III neutral subjects (20 males, 20 females, SN–Mn plane angle: 32 ± 2.5°), and 41 Class I normal occlusion subjects (20 males, 21 females). The intercanine, interpremolar, and intermolar widths of the maxillary and mandibular study casts were measured, following which the ratios of dental width to basal width and mandibular width to maxillary width were obtained.
RESULTS: In the Class III malocclusion group there was no significant difference in any ratios for the different vertical patterns between the hyperdivergent and neutral group. In the Class III malocclusion group compared with normal occlusion group, the maxillary teeth flared buccally to the basal bone, and the mandibular teeth tilted lingually to the basal bone. The maxillary basal arch width relative to the mandibular arch of the Class III malocclusion group was narrower in the canine and molar regions than that in the normal occlusion group, whereas the ratio of the maxillary to mandibular dental arch of the Class III malocclusion group was similar to that of the normal occlusion group in all regions.
CONCLUSIONS: In Class III patients, the maxillary basal arch width is narrower than the mandibular basal arch width, but the relationship of the mandibular and maxillary dental arch width is similar to the normal group.

190 COMPARISON OF SHEAR BOND STRENGTH OF SELF-ETCH PRIMER AND GLASS IONOMER CEMENT

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AIM: To compare the shear bond strength of orthodontic metal brackets (Victory Series™, 3M Unitek) bonded with the newly introduced self-etch primer (Transbond™ Plus Self Etching Primer, 3M Unitek) and glass ionomer cement (GIC; Fuji Ortho™ LC, GC Corporation) under dry and moist conditions.
MATERIALS AND METHODS: One hundred and twenty-five extracted human premolars with intact enamel were collected and stored in a solution of 0.2 per cent thymol. The teeth were cleaned with pumice and rubber prophylactic cups for 20 seconds. The teeth were divided into five groups. Group I (control group): 25 teeth were etched with 37 per cent phosphoric acid gel. The brackets were bonded with Transbond XT™ (3M Unitek) and light cured for 20 seconds. Group II: the self-etch primer (Transbond™ Plus) was applied for 3 seconds to the dry enamel surface of 25 premolars and afterwards the brackets were bonded with Transbond XT™. Group III: Transbond™ Plus was applied to the moist surface of 25 premolars according to the manufacturer's instructions. Group IV: GIC was applied to the enamel under dry conditions. Group V: GIC was applied to the enamel under moist conditions. The shear bond strength was determined using a universal testing machine. Statistical analysis of the data was performed using the *post hoc* test ($\alpha = 0.05$).
RESULTS: The self-etch primer showed significantly higher shear bond strength than the control in dry and moist conditions. The bond strength of the GIC groups IV and V was significantly lower than in groups I, II, and III ($P = 0.000$).
CONCLUSIONS: Group III (self-etch primer; Transbond XT™) is the most suitable bonding system due to the high shear bond strength.

191 SPACE CLOSURE AFTER FIRST MOLAR EXTRACTIONS

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AIM: To examine the extent of space closure after first molar extractions independently of caudal expansion of the dental arch in young patients.
SUBJECTS AND METHODS: Twenty-four patients (aged 9 years 6 months to 16 years 11 months, average 11 years 6 months) from an orthodontic practice in Sachsen-Anhalt were examined (nine males with a total of 13 first molars extracted and 15 females with 25 extracted first molars). Space closure commenced immediately following the extractions. Dental pantomograms were analysed before and after space closure. The construction of the skull was characterized from lateral view radiographs. A connecting line was drawn between the premolars and was added by the axes of the second molars. The distances between the most caudal point of the recessus and the connecting line between the premolars were measured. The expansion factor was evaluated.
RESULTS: After orthodontic therapy a good axial position between the premolars and the second molars was achieved in 15 subjects (divertion of axes <10 degrees, minimum 1.5 degrees, maximum 9.5 degrees, average 6.3 degrees). In 23 patients the diversion was higher than 10 degrees (min. 11.5, max. 33.5, average 16.5). Following extraction of 38 first molars, the distance between the most caudal point of the recessus and the connecting line between the premolars was reduced 31 times (min. 1.2 mm, max. 14.0 mm, average 4.4 mm). At the counter-clockwise growth 20 of those measured showed a deeper recessus (min. 1.2 mm, max. 14.0 mm, average 4.8 mm). In subjects with clockwise growth six of the 10 measurements showed a deeper recessus (min. 2.2 mm, max. 4.9 mm, average 3.4 mm).
CONCLUSION: Despite treatment commencing immediately after the extractions there was a deepening of the recessus in 81.6 per cent of subjects, i.e. the parallel positioning of the second permanent molar axes was realized with more difficulties.

192 SIGNIFICANCE OF CEPHALOMETRIC VARIABLES FOR TREATMENT OUTCOME

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AIM: To investigate whether cephalometric variables can be used to predict anticipated growth and treatment associated changes.
MATERIAL AND METHOD: Pre-treatment lateral cephalograms of 43 randomly selected moderate Class II division 1 patients (mean distal occlusion pre-treatment: 6.75 ± 5.97) were examined. All were treated with removable as well as fixed appliances.
RESULTS: Significant differences (paired *t*-test) between pre- and post-treatment occlusion were found ($P < 0.001$). Pre-treatment mean values of the performed cephalometric measurements were: (SNA 78.51 ± 3.43; SNB 75.31 ± 3.73; ANB 3.99 ± 1.92; SNAr 125.76 ± 5.29; SNBa 133.01 ± 4.76; Go 122.60 ± 10.31; NP 8.21 ± 3.06; MP 33.08 ± 5.09; NP:MP 23.94 ± 5.79; Wits 1.49 ± 2.51). Multiple regression analysis showed a poor correlation coefficient (CC) between pre- and post-treatment occlusion (CC 208). Including all cephalometric measurements, only a weak correlation between these variables and the post-treatment occlusion was found (CC 646). This means that only 41 per cent of variability between cephalometric measurements and post-treatment occlusion are based on their linear correlation. Stepwise backward exclusion of cephalometric variables corresponding to the order of their predictive power resulted in a decreasing correlation factor (CC 460).
CONCLUSION: Pre-treatment occlusion and cephalometric measurements are not indicative of treatment outcome. Obviously there are many parameters of considerable importance to therapy and treatment success so predictions cannot be made with sufficient accuracy and precision to be useful in treatment planning and delivery.

193 X-RAY PROTECTION OF CHILDREN—THE ROLE OF THE THYROID GLAND

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AIM: Evaluation of a method to protect the thyroid gland against direct or extrafocal radiation during radiographic examinations for orthodontic diagnosis.
MATERIALS AND METHODS: To introduce a thyroid lead protection (thyroid lead shield, TLS) for children, a dried skull study was examined to evaluate artefacts and/or interferences concerning cephalometric analysis. To simulate positioning errors the skull with a TLS was rotated stepwise around the *x*-, *y*-, and *z*-axes. Every 5 degrees of rotation on postero-anterior (PA) and lateral head film were obtained and a cephalometric analysis was performed. In a follow-up study 100 randomly selected radiographs were analysed regarding patient's age, head size, and other handicaps that could produce errors in the routine use of a TLS. To test the effects of inter-observer reproducibility of landmark placement, all radiographs were evaluated independently by two orthodontic specialists.
RESULTS: Compared with the natural head position, angulations of the dried skull up to 20 degrees in all planes showed no significant effect on cephalometric analysis. On PA radiographs in cases with more than 20 degrees flexion there is a risk of the TLS covering the chin. Lateral radiographs are less sensitive than PA radiographs concerning positioning errors. The TLS had no influence on hard tissue landmark placement.
CONCLUSIONS: The TLS is an easy to use, low-cost, and valuable tool to keep the radiation dose as low as reasonably achievable.

194 A COMPARISON OF SKELETAL AND NORMAL GROWTH CHANGES DURING FACEMASK THERAPY

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AIM: To investigate the orthopaedic effect of protraction headgear during orthodontic treatment.
MATERIALS AND METHOD: Longitudinal lateral cephalometric radiographs of 32 Class III patients (15 males, 17 females, mean age 11.5 years) treated at one centre with protraction headgear therapy, supervised by one operator. Twenty-four points were digitized on the lateral cephalograms of each patient and treatment change profiles were prepared. These were compared with growth profiles from the Bhatia/Leighton growth study (1993) and also with the results of a concurrent longitudinal growth study of 50 untreated Class III patients (Kangesu, 2000).
RESULTS: There were no significant skeletal changes noted for the male or female groups. There were minimal changes to the angles SNA and SNB with protraction therapy, which were not statistically significant. However, when the effects of these were combined, as reflected in the ANB angle, there was a significant improvement in the skeletal Class III relationship. The dentoalveolar changes in the treated sample were more significant; the upper incisors proclined by 5.69 degrees and the lower incisors retroclined by 5.96 degrees. The change in overjet was on average 2.62 mm.
CONCLUSION: The beneficial effects of protraction headgear therapy are limited to the dentoalveolar structures. However, the average age of 11.5 years may be too late for the application of protraction headgear to affect skeletal structures.

195 VARIABILITY OF COMPUTERIZED AND TRADITIONAL CEPHALOMETRIC ANALYSES OF FRONTAL RADIOGRAPHS

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AIM: To compare the results obtained using computer-assisted frontal cephalometric analysis with traditional (manual) methods.

MATERIALS AND METHOD: Fifty-nine standardized frontal radiographs were used. Only one observer made all cephalometric measurements. Six parameters of Ricketts' frontal analysis incorporated into the software of Nemoceph 3.0 (Nemotec) were used. Cephalometric measurements of all 59 frontal radiographs were made both by manual and computerized methods. Differences between the methods were statistically evaluated.
RESULTS: Standard deviation values between the two methods varied from 0.4 mm (measurement of lower to upper dental midline) to 1.7 mm (occlusal plane inclination).
CONCLUSIONS: Computer-assisted methods may be valid for assessing cephalometric parameters based on landmarks with low localization error. Studies such as this are useful to evaluate the reliability of computer cephalometric versus traditional methods.

196 TREATMENT EFFECTS AND LONG-TERM CHANGES AFTER FACEMASK THERAPY IN CLASS III PATIENTS

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AIM: To evaluate treatment effects and long-term post-treatment changes in Class III patients following palatal expansion and maxillary protraction.
SUBJECTS AND METHODS: Seventeen Class III patients treated by maxillary expansion and protraction. The pre-treatment age ranged from 4.7 to 10.5 years with a mean of 8.1 years. Active treatment time with the facemask was 5.3 months (range 2–14.5 months) and the follow-up period was 11.2 years (range 6.5–12.4 years). Cephalograms and study models taken before (T1) and after treatment (T2) and at follow-up (T3) were analysed. Statistical significance was tested using the repeated-measures analysis of variance. $P < 0.05$ was interpreted as statistically significant.
RESULTS: Treatment resulted in a significant improvement of the maxillo-mandibular relationship and overjet. The facial profile became more convex, ANB and SNA angles and midface length increased. Pogonion was displaced posteriorly resulting in a less progenic profile. The mandibular growth pattern changed towards an opening type but remained in the neutral range. The palatal and occlusal planes tilted upward. Lower anterior face height increased but the change was not statistically significant. The molar relationship was corrected towards Class I during treatment but relapsed during follow-up. The mandibular incisors inclined lingually during treatment but moved labially during follow-up. A positive overjet was obtained in all patients and maintained during follow-up in all but one subject. All patients showed reversal towards skeletal Class III features during the follow-up period.
CONCLUSION: Facemask treatment in Class III patients during the mixed dentition results in an improved maxillo-mandibular relationship and more harmonious profile. Overcorrection is recommended to compensate for excessive growth of the mandible and deficient growth of the maxilla.

197 CRANIOFACIAL DISTRACTION OSTEOGENESIS: THE ORTHODONTIC PERSPECTIVE

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AIM: To review the literature dealing with clinical and experimental craniofacial distraction osteogenesis (DO) from an orthodontic perspective for the purpose of (1) assessing clinical indications and DO parameters, and (2) evaluating different DO experimental animal models.
MATERIALS AND METHOD: A PubMed search (NCBI, New Pubmed System) from 1966 to December 2000 was conducted. Key words applied in the search were distraction, orthodontics, lengthening, mandible, maxilla, midface, monobloc, cranial, craniofacial, and maxillofacial. The clinical and experimental search revealed 109 and 120 articles, respectively. Flow sheets were made of each article with all relevant parameters relative to DO and orthodontics.
RESULTS: A total of 828 patients underwent craniofacial DO: 579 (70.0 per cent) mandibular, 129 (15.6 per cent) maxillary, 24 (2.9 per cent) simultaneous mandibular-maxillary, and 96 (11.6 per cent) midfacial and/or cranial. Only 479 patients (57.9 per cent) had data on follow-up and for only 248 patients (30.0 per cent) was information on relapse given. A total of 1207 animals were used in seven different animal models: 54 (45.0 per cent) dog, 25 (20.8 per cent) rabbit, 18 (15.0 per cent) sheep, 11 (9.2 per cent) minipig, seven (5.8 per cent) monkey, four (3.3 per cent) rat and one (0.8 per cent) cat model. Only three (2.5 per cent) articles investigated orthodontic tooth movement in the regenerate and only two (1.7 per cent) relapse.
CONCLUSION: Based on these results an attempt was made to provide treatment protocols and success criteria for clinical craniofacial DO and guidelines for future experimental DO research. There is still a lack of sufficient data, especially on orthodontic management, dental-skeletal relapse and follow-up, so that treatment strategies have to be validated.

198 CORE BINDING FACTOR a1 COUPLES CHONDROCYTES MATURATION AND ENDOCHONDRAL OSSIFICATION IN THE CONDYLE

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AIM: To determine the temporal pattern of core binding factor a1 (Cbfa1) expression in condylar cartilage during post-natal mandibular growth.
MATERIALS AND METHODS: Twenty-five female Sprague–Dawley rats, 35 days of age, were divided into five groups and sacrificed after 3, 7, 14, 21, and 30 days,

respectively. An immunohistochemical study using two types of Cbfa1 antibody was designed to examine its expression in condylar cartilage. Staining of collagen II and acid phosphatase activity was also carried out to differentiate the cartilage layers. The amount of positive Cbfa1 signal was quantified to clarify its temporal pattern of expression.
RESULTS: Type I Cbfa1 was limited in the chondrocyte layer before 49 days of age, while type II Cbfa1 was localized in the osteoclasts and osteoblasts in the mineralization front. The high level of type I Cbfa1 expression in both the chondrocyte layer and hypertrophic layer on day 56 indicated the terminal differentiation and maturation of the chondrocytes. At the same time, active endochondral bone formation was taking place, as indicated by increased type II Cbfa1 staining.
CONCLUSION: Two types of Cbfa1 couple and regulate the pace of chondrocyte maturation and endochondral ossification during mandibular condylar growth. Cbfa1 expression could be used as an indicator to monitor the adaptive response of condylar cartilage in future studies.
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199 EFFECTS OF ORTHODONTIC TREATMENT ON FACIAL EXPRESSIONS WITH COMPUTER GRAPHICS

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AIM: To investigate the effect of orthodontic treatment on facial expressions using a special computer system.
SUBJECTS AND METHODS: Facial expression is defined as the movement of some grid points in a generic three-dimensional face model. A personal frontal facial image was manually adjusted to a generic model. Facial expressions of a personal facial model could be produced according to Action Units on Facial Action Coding System (FACS). Six averaged facial images were made of three groups from pre- and post-treatment facial photographs. One group was treated for mandibular protrusion, the second for maxillary protrusion, and the third for crowding. Each group comprised five Japanese female patients. Six expressions (surprise, fear, disgust, anger, happiness, and sadness) were produced from the averaged facial image of the three groups before and after orthodontic treatment. Ninety-nine Japanese and 40 Chinese subjects had their expressions estimated.
RESULTS: The happy face produced following treatment of maxillary protrusion was selected by 55 per cent of the Japanese and 23 per cent of the Chinese subjects. The averaged photographs displaying fear, disgust, and sad faces produced following treatment of crowding were expressed in a deeper way. Surprise produced from pre-treatment of maxillary protrusion was expressed in a deeper way. There was a difference of the sensitivity in the facial expression of anger in Japanese and Chinese ($P < 0.01$).
CONCLUSIONS: The form of the lips and the facial expression change following orthodontic treatment.

200 THE USE OF FIBRE REINFORCED COMPOSITE AS AN ORTHODONTIC TOOL

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AIM: To measure the maximum shear force and to demonstrate the versatility of fibre reinforced composite (FRC) as an orthodontic tool.
MATERIAL AND METHOD: In an *in vitro* study glass FRC (Splint-it™, Jeneric/Pentron, Wallingford, Connecticut) were used. Two different types of FRC strips were tested: 3 mm uni-directional and 2 mm woven fibre, each with a thickness of 0.3–0.5 mm. In order to standardize the testing conditions, hydroxyapadite stones were used instead of human enamel. The FRC attachment was tested under five loading conditions.
RESULTS: With forces parallel to the hydroxyapatide surface and through the centre of the pad, the pad–FRC strip combination withstood loads two to three times greater (200 N) than the metal pad alone. When a force and a shearing moment parallel to the hydroxyapatide surface was applied, the pad–FRC combination was approximately three times greater (40 N) than the bonded pad alone. Inspection of the specimens and photomicrographs showed that failure generally occurred within the FRC strip or at the hydroxyapatide surface. Consecutively FRC was used as an orthodontic tool for a variety of tooth movements.
CONCLUSION: Fibre-reinforced bars offer a viable method of bonding to either individual or groups of teeth, and full arches; brackets, or tubes can safely be bonded to the bars for active tooth movement.

201 APPRAISAL OF THE APICAL BASE OF DENTAL ARCHES WITH CROWDING

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AIM: To examine the percentage ratio and determine the degree of discord of the width and length of the apical base and the mesiodistal diameters of the 12 permanent teeth in both dental arches in subjects with normal occlusion and in those with dental crowding, according to the percentage values of those with normal occlusion.
SUBJECTS AND METHODS: Sixty patients, 14–18 years of age, with dental crowding were examined and compared with a control group of 30 subjects with normal occlusion. Appraisal of the apical base of the dental arches was performed on plaster study models and profile teleroentgen films of each subject. The dependence between the apical base and dental arches was calculated using Howes' formula.
RESULTS AND CONCLUSION: The width and length of the maxillary apical base showed a high statistical significance between the groups. There was an expressive discord between the dimensions of the apical base and the maxillary dental arch. There was no statistical significance between the width

and length of the mandibular apical base between the groups. There was no discord between the apical base and the lower dental arch.

202 CORRELATION OF REPLICATING CELLS AND OSTEOGENESIS IN THE CONDYLE DURING STEPWISE ADVANCEMENT

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AIM: To quantify the number of replicating mesenchymal cells and to correlate it to the amount of bone formation in the condyle during stepwise advancement.
MATERIAL AND METHODS: Two hundred and fifty female Sprague–Dawley rats, 35 days old, were randomly divided into 10 control groups (n = 5) and 20 experimental groups (n = 10). Fifty rats from the stepwise experimental group received a 2 mm advancement initially and veneers were added on day 30 with another 1.5 mm advancement. The rats were sacrificed after 3, 7, 14, 21, 30, 33, 37, 44, 51, and 60 days. One hour before death all rats were injected with bromodeoxyuridine intravenously. Tissue sections of 7 µm were cut through the condyle in the sagittal plane and stained with anti-BrdU antibody to evaluate the number of replicating mesenchymal cells. Haematoxylin stain was applied to observe cellular response.
RESULTS: During the first advancement, the replicating mesenchymal cells in the posterior region of the condyle showed the highest increase on days 14 and 21 when compared with the control, which preceded the increase in bone formation on days 30, 33, and 37 of advancement. On the second advancement another increase of replicating cells was evident on day 51, along with a significant increase in bone formation observed on day 60.
CONCLUSION: Forward positioning of the mandible in a stepwise manner delivers mechanical strain that solicits an increase in the number of replicating mesenchymal cells in the condyle. The increase in the population size of the osteoprogenitor cells subsequently leads to more bone formation.
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203 LONG-TERM FOLLOW-UP OF EARLY TREATMENT WITH REVERSE HEADGEAR

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AIM: To investigate long-term dental and skeletal changes in patients who had received early treatment with reverse headgear.
SUBJECTS AND METHODS: Thirty patients with a skeletal Class III malocclusion due to a retrognathic maxilla who had undergone treatment with reverse headgear at 8 ± 1.7 years of age. All subjects had a positive overjet at the end of treatment. At the 8-year follow-up, 21 subjects remained in the study. At the start of treatment, there was no difference in the dentofacial morphology between the drop-outs and those who remained in the sample. This sample was divided into stable (n = 14) and relapse (n = 7) groups by means of positive and negative overjet, respectively. The cephalograms obtained at the start and end of treatment and 8 years post-treatment were analysed according to Pancherz (1982).
RESULTS: Sagittally: during active treatment, there was no significant difference between the two groups. At the 8-year follow-up overjet differed 4.6 mm** between the stable and relapse groups, due to more favourable skeletal changes, 5.8 mm** in the stable group. In the stable group the mandible outgrew the maxilla 2:1, and in the relapse group 4:1. Vertically: during active treatment, there was a statistically significant reduction of the overbite only in the relapse group (–3.0***). The mandibular plane angle increased significantly in both groups, and significantly more in the relapse group ($P < 0.05$). There was no statistically significant difference in the vertical changes between the two groups during the follow-up period.
CONCLUSIONS: In the long-term, one-third of young skeletal Class III patients with a retrognathic maxilla treated with reverse headgear will relapse. The majority of these patients will require combined orthodontic–surgical treatment.

204 CHANGES IN TRANSVERSE PALATAL VAULT DIMENSIONS AFTER CROSSBITE TREATMENT

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AIM: To assess the effects of expansion of the maxillary dental arch by three different treatment modalities (Hyrax, quad-helix, and expansion plate) on the transverse dimension of the palatal vault.
SUBJECTS AND METHOD: Forty-two children with unilateral or bilateral crossbite were treated using Hyrax (n = 20), quad-helix (n = 9), or expansion plate (n = 13). A group of 30 children with orthodontic treatment limited to the lower dental arch was used as the control. Dental casts, before and after treatment, were scanned in a three-dimensional (3D) laser scanner. 3D superimposition of the images of the palatal vault was performed based on the area of the palatal rugae and the midpalatal zone. Measurements were carried out under standardized conditions evaluating three transverse sections at the first and second premolar and first molar regions.
RESULTS: In the expansion group the transverse mean dimension of the palatal vault was increased in all the areas measured. The most pronounced changes were found in the first molar section, with an average of 2.7 mm (SD: 2.2). These changes were larger ($P \leq 0.001$) than those observed in the control group with an average increase of 0.3 mm (SD 1.2). Among the expansion appliances used, the Hyrax caused the most marked effect.

CONCLUSIONS: The use of expansion appliances in the treatment of lateral crossbites causes effects in the transverse dimension of the palatal vault. These changes may be related to the different mode of expansion used.

205 ARE WE EXTRACTING TOO MANY TEETH?

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AIM: To assess the relative frequency of extraction versus non-extraction therapy in a consecutive series of patients treated in a large health region of the United Kingdom.
MATERIAL AND METHOD: Hospital and specialist practitioner orthodontists in the region were requested to record 20 consecutively treated finished cases on a data sheet over a stated time period. The information recorded included age/sex, malocclusion type, appliance used, Index of Orthodontic Treatment Need (IOTN) grade, and extractions carried out if any.
RESULTS: The response rate was approximately 50 per cent. The survey included 458 patients undergoing treatment, with 59 per cent being female. The average age was 14 years, and 90 per cent of the cases were assessed as IOTN 4/5. Cases requiring extractions accounted for 57 per cent of the total treated. The commonest extraction pattern was four first premolars (22 per cent), followed by upper first premolars with lower second premolars (15 per cent). Extraction of the first permanent molars was uncommon at only 2 per cent. Second permanent molars were removed in 5 per cent of subjects. Comparison of the extraction and non-extraction groups indicated a very similar case mix. However, significantly more functional appliances were used in the non-extraction cases (29 per cent compared with 6 per cent). The use of headgear was very similar in the two groups.
CONCLUSIONS: In the United Kingdom current orthodontic debate has centred on allegations that too many teeth are being removed. Evidence for this statement is scant. This regional study indicates an extraction:non-extraction ratio of approximately 60:40. Therefore, 60 per cent of patients seeking orthodontic treatment in this region might expect to undergo dental extractions. An individual practitioner's extraction rate can be compared with this regional average.

206 SKELETAL AND DENTAL CHANGES ASSOCIATED WITH EXTRACTION OR NON-EXTRACTION TREATMENT OF CLASS II DIVISION 2 MALOCCLUSIONS

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AIM: To evaluate the skeletal and dental changes associated with the treatment of Class II division 2 malocclusions.
SUBJECTS AND METHOD: Twenty Class II division 2 patients between 12 and 27 years of age. Of these patients, nine were treated with extractions and 11 without extractions. Pre- and post-treatment lateral cephalograms were used and a total of 19 measurements were carried out. Collected data were analysed using paired *t*-tests for intragroup comparisons and the Student's *t*-test for intergroup comparisons.
RESULTS: Statistical analysis of the results demonstrated statistically significant differences between the measurements of SNB, ANB, overbite, U1–A–Pog (mm and deg), U1–PP (mm and deg), L1–A–Pog (mm and deg), IMPA, interincisal angle, U6–PP (mm) within the whole sample. When the results from the extraction and non-extraction groups were compared, U1–A–Pog (mm), L1–A–Pog (deg), IMPA, and interincisal angle measurements showed significant differences between groups.
CONCLUSION: Correction of a deep overbite was mainly related to upper and lower incisor protrusion and some upper incisor intrusion. Little or no intrusion was observed in the lower incisors. The deep bite correction mechanism was the same in both extraction and non-extraction groups. Being aware of the mechanism of correction of Class II division 2 malocclusions will result in improvement in treatment planning and forecasts.

207 THE EFFECT OF ENAMEL ETCHING WITH DIFFERENT ACIDS ON THE BOND STRENGTH OF METALLIC BRACKETS

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AIM: To compare the bond strengths of metallic brackets on human enamel etched with different acid solutions.
MATERIAL AND METHOD: Group 1, 37 per cent phosphoric acid; Group 2, 10 per cent maleic acid; Group 3, 37 per cent phosphoric acid with 1.23 per cent NaF addition; Group 4, 10 per cent maleic acid with 1.23 per cent NaF addition; to reveal whether this caries prevention modality adversely affects the clinical success of bonding procedure. All groups had stainless steel brackets (Dentaurum, Standard Edgewise) bonded to the buccal surface of each tooth with no-mix adhesive (Express Dental Products, Toronto, Canada). An Instron testing machine (Instron Corp., Canton, Massachusetts) was used to determine tensile bond strengths at a crosshead speed of 0.5 mm/minute. Statistical analysis was carried out using an analysis of variance and Duncan's multiple range tests.
RESULTS: The mean bond strength values of the groups were as follows: Group 1, 9.17 ± 4.59 MPa; Group 2, 8.46 ± 3.89 MPa; Group 3, 2.33 ± 2.19 MPa; Group 4, 2.02 ± 1.43 MPa. The bond strengths of the two 'only acid' groups were significantly higher than the NaF added groups and were statistically similar.
CONCLUSION: Ten per cent maleic acid alone may produce similar bond strengths to 37 per cent phosphoric acid. However, 1.23 per cent NaF addition to either phosphoric or maleic acid to increase caries resistance results in significantly lower bond strengths and is not be advocated for clinical use as an enamel conditioner.

208 CRANIOFACIAL MORPHOLOGY OF UNILATERAL CLEFT LIP AND PALATE AT 6 YEARS OF AGE

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AIM: A retrospective follow-up study of unilateral cleft lip and palate (UCLP) craniofacial morphology at 6 years of age following a revised surgical protocol since 1986, compared with the previous UCLP protocol and a non-cleft group.
SUBJECTS AND METHOD: Fifty-three UCLP children (39 males, 14 females) who had lip closure using the Millard technique with Vomer flap at 3 months of age and palatal closure by von Langenbeck technique at 18 months of age. The previous UCLP group, comprising 20 males, had lip closure by theTennison technique, including periosteoplasty at 3 months of age and palatal closure by pushback at 24 months of age. All operations were performed at the University Hospital of Bergen, Norway. Both UCLP groups had a mean age 6.2 years. The control group comprised data from a mixed longitudinal study of Norwegian non-cleft children aged 6.9 years. Standardized lateral cephalograms collected at 6 years of age were traced and digitized twice with a 2-week interval by one investigator. Differences between the groups were analysed by two-sample *t*-tests.
RESULTS: Compared with the previous UCLP group, the revised UCLP group showed similar facial profiles. In comparison with the non-cleft group, the revised UCLP showed a retrognathic midface with vertical and sagittal restriction of the posterior palate.
CONCLUSIONS: Follow-up studies are vital for quality assurance and quality improvement of cleft lip and palate (CLP) treatment. This study did not reveal any significant differences in facial morphology at 6 years of age in the UCLP subjects treated following two different CLP repair protocols. The outcome at 6 years old was considered favourable; however, multidisciplinary long-term treatment evaluation until adulthood is indispensable.

209 BIOGLASS, CHEMICAL COMPOSITION, AND BIOINTEGRATION IN A CRITICAL SIZE RAT CALVARIAL DEFECT

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AIM: To evaluate the chemical composition of 45S5Bioglass® by Fourier-Transmittance-Infrared (FTIR) spectroscopy and its influence on the healing of critical size bone defects by means of micro-computed tomography (μCT), histology, and histomorphometry.
MATERIAL AND METHODS: Bilateral critical size defects, 5 mm in diameter, were created in the calvarial bone of 24 rats. A mixture of Bioglass and autogenous blood filled the experimental side; the control side was left untreated. After sacrifice at 28 days, the defect sites were removed, fixed, and embedded in methylmetacrylate. The defects were evaluated by μCT-scanning and thereafter sections were prepared and stained for histology and histomorphometry.
RESULTS: The FTIR spectroscopy of Bioglass displayed a spectrum typical of silicate glass. The μCT-scan evaluation was carried out on 14 of the specimens and showed improved healing on the implanted side. However, the Bioglass and bone had similar grey-values, making the differentiation between them on three-dimensional reconstruction impossible. Histological analysis demonstrated that no defects were healed. The edges of the defects showed formation of osteoid-covered woven bone. However the bone never bridged the defects, which were instead filled by a dense fibrous connective tissue. The experimental defects were filled by the Bioglass particles surrounded by concentrically arranged fibrous connective tissue with a minor chronic inflammatory reaction. The Bioglass particles displayed only slight signs of dissolution. Histomorphometry demonstrated that the volume fractions of bone and fibrous tissue were significantly larger in the control than in the experimental side.
CONCLUSION: The Bioglass was neither osseoinductive nor osteoconductive, but acted as an inert space-filler incorporated in fibrous connective tissue. A distinction between 45S5 Bioglass® particulate and bone on radiographs was impossible, which clinically may imply a false positive interpretation.

210 MOTOR EFFECTS IN THE HUMAN MASSETER MUSCLE FROM TEMPORARY OCCLUSAL CHANGES

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AIM: To determine the effects of an experimental occlusal interference on the motor activity of the human masseter muscle.
SUBJECTS AND METHODS: Ten young females (mean age ± SD; 19.7 ± 1.1 years) with no history of temporomandibular disorders, participated in this double-blind crossover study. After baseline recordings, each subject was randomly assigned to the first experimental or control condition, each with a duration of one week. In the experimental condition, a custom-made gold active interference (height 250 mm) was applied on the lower first molar disturbing the intercuspal position. In the control condition, a non-active interference was placed on the same tooth without interfering with the intercuspal position. After a wash-out period of 2 weeks, each subject returned, and the interference was applied in a reverse order. The masseter activity was monitored 8 hours a day in the natural environment by means of portable one-channel EMG recorders. The number and duration of the activity periods (AP), their mean amplitude, and the integral of AP versus time (IEMG) were calculated.

RESULTS: Compared with the control condition, AP and IEMG were significantly lower during the experimental condition (repeated measurement ANOVA: $P < 0.01$).
CONCLUSION: The application of an active experimental occlusal interference induces a reduction in long-term masticatory activity in the masseter muscle.

211 ANTI-PLAQUE AND ANTI-GINGIVITIS EFFECTS OF CHLORHEXIDINE CHEWING GUM DURING FIXED ORTHODONTIC THERAPY

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AIM: To investigate the anti-plaque and anti-gingivitis effects of chlorhexidine chewing gum in adolescent patients during fixed orthodontic therapy when compared with placebo chewing gum and repeated oral hygiene instruction.
SUBJECTS AND METHODS: A single-blind, parallel-design clinical trial was carried out in 47 adolescent patients referred to an orthodontic private practice. Prior to the start of the study, each patient underwent a pre-study screening to check whether they fulfilled the inclusion criteria. All were treated with Begg appliances in the upper and lower arches. The teeth were directly bonded brackets, except for the first molars, which were banded. At baseline (2–6 months after appliance placement), the following parameters were scored (except for the third molars): modified Gingival Index (GI; Lobene *et al*., 1986), Staining Index (Moradi Sabzevar and Adriaens, 1997), Calculus Index (Volpe *et al*., 1967), Bleeding on Probing and Visual Plaque Index (BOP, VPI; Turesky *et al*., 1972) as well as the Plaque Index around the brackets (BBPI; Ciancio *et al*., 1984). After recording baseline scores, all subjects received professional dental prophylaxis in order to completely remove existing plaque, calculus, and staining. The same parameters were evaluated at 1, 2, and 3 months. The patients were randomly assigned to three groups: chlorhexidine group (CHX) (continuing existing oral hygiene procedures in conjunction with chewing two pieces of chlorhexidine chewing gum for 10 minutes), the placebo group (PLA) (continuing existing oral hygiene procedures in conjunction with chewing two pieces of chlorhexidine-free chewing gum for 10 minutes) or the oral hygiene instruction group (OHI). These patients were asked to continue their existing oral hygiene routine but not to consume any chewing gum. In contrast with the two other groups, this group was monitored at each evaluation session and OHI was reinforced if plaque or calculus was present. All patients received professional prophylaxis at the end of the 3-month examination.
RESULTS: No significant differences were found between the CHX and OHI groups or between the OHI and PLA groups for the modified GI. However, at months 1 and 2, the PLA group showed a statistically significant reduction in GI compared with the CHX group. For BOP, VPI, and BBPI, no significant differences were found between the three groups at any time interval. A significant increase in calculus and stain formation was observed between the CHX and the two other groups.
CONCLUSION: There was no additional effect of chlorhexidine chewing gum on periodontal status when compared with placebo chewing gum and repeated OHI. Whilst the chlorhexidine chewing gum significantly increased staining and calculus formation, in clinical terms this was not aesthetically disturbing.

212 FIBROBLAST AND PLATELET-DERIVED GROWTH FACTOR RECEPTORS IN THE GROWING MANDIBULAR CONDYLE

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AIM: To elucidate the role of fibroblast growth factor 1 and 3 (FGF-1, -3) and platelet derived growth factor (PDGF) in the growth of the rat mandibular condylar cartilage.
MATERIALS AND METHODS: Twenty-four Long-Evans/Turku rats (three in each group) aged 1–21 days. The animals were killed with an overdose of carbon dioxide and thereafter decapitated. The heads were fixed in 4 per cent paraformaldehyde, decalcified in 12.5 per cent EDTA, cut sagittally into two halves and sectioned sagittally at 6 µm. In order to detect FGF-1, -3 and platelet derived growth factor (PDGF) receptors the sections were treated with H_2O_2/methanol (1:100), whereafter FGF-1 and PDGF monoclonal and FGF-3 polyclonal antibodies were applied. The reaction products were visualized using the Vectastain ABC Elite Kit using DAB substrate. Negative and positive controls were also prepared. The sections were counterstained with haematoxylin. In order to measure the depth of the cell layer labelled with FGF-1, -3 and PDGF receptors, the condylar head was divided into four regions: anterior, superior, posterosuperior, and posterior. The measurements were made perpendicular to the articular surface using a computerized image analysis system, the images being acquired by means of a microscope connected to a CCD camera. The mean of five equally distributed measurements of each region was used to indicate the depth of the cell layers secreting the receptors. Regression analysis was used to evaluate the association between the depth of the labelled cell layer in relation to total depth of the condylar head, as a function of age.
RESULTS: The depth of the cell layer labelled for FGF-1, -3 and PDGF increased significantly as a function of age in the mandibular condylar head of rats.
CONCLUSIONS: An increase in the cell layer labelled for FGF-1, -3 and PDGF occurs during the stage when articular function of the mandibular condyle intensifies. FGF-1, -3 and PDGF evidently have an important role in growth regulation of the condylar cartilage during the most rapid growth period in the rat.

213 LOW AND HIGH FORCES SHOW COMPARABLE HISTOLOGICAL REACTIONS DURING EXPERIMENTAL TOOTH MOVEMENT

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AIM: Histological evaluation of the periodontal ligament during tooth movement with two different forces.
MATERIAL AND METHOD: Fifteen young adult beagle dogs with a complete permanent dentition. Mandibular implants were placed 3 months after extraction of the third and fourth premolars. Three months later an orthodontic appliance was placed on the implant, exerting a constant reciprocal force on the second premolar and first molar. A force of 25 or 300 cN was used at the different sides of the mandible. Time–displacement curves were constructed of the mesial movement of the first molar and the distal movement of the second premolar. Histochemical evaluation was performed on paraffin and cryo-section after 1, 4, 20, 40, or 80 days of active treatment. Haematoxylin and eosin, alkaline phosphatase, and tartrate resistant acid phosphatase stainings were used.
RESULTS: The sequence of the events was as expected: initial stretching and relaxation of the periodontal fibres. On the pressure side this was mostly followed by hyalinized tissue formation and undermining bone resorption, subsequent removal of the hyalinized tissue, and finally an increase in osteoclastic activity and bone resorption. On the tension side osteoblastic activity was increased and bone deposition was found. It was, however, surprising that these events, including hyalinization, were encountered in all experimental conditions (25 or 300 cN on a molar, and 25 or 300 cN on a premolar) and at all time points (from 1 to 80 days of active force application).
CONCLUSIONS: Hyalinization can be evoked by a wide range of forces and throughout the whole period of orthodontic tooth movement. Even with low forces hyalinization cannot be completely prevented.

214 FREQUENCY OF FACIAL AND POSTURAL PAIN IN ORTHODONTIC PATIENTS

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AIM: To investigate the frequency of pain in the orofacial and the neuromuscular system of orthodontic patients.
SUBJECTS AND METHOD: One hundred children (49 males, 51 females) were interviewed concerning the frequency of facial and postural pain and evidence of accidents during school sport lessons. All subjects were interviewed using a standard protocol. The answers were prescripted, or a scale was used to produce a high reliability of the data.
RESULTS: A relatively high percentage of the patients (88 per cent) reported having had a headache at any time. Twelve per cent stated that they had a headache more than three times a week. Most of the patients had been living with pain for a long time. Patients with pain in the neuromuscular system had often been involved in accidents whilst playing sport.
CONCLUSIONS: There is a high dependence between the frequency of pain and accidents during training at school. The high rate of patients with pain in this age group shows the responsibility of the orthodontist for preventing damage to the neuromuscular system.

215 DEVELOPMENT OF A NEW COMPOUND PALATAL ARCH

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AIM: To develop and biomechanically investigate a new palatal arch that would demonstrate physiological forces and more effective moments and rotational forces than conventional palatal arches. The compound palatal arch is a completely new concept and a further development of the compound wire technique (Wichelhaus *et al*., 1995). The advantage of this method of treatment is that the forces and moments applied to the teeth are within physiological limits.
MATERIALS AND METHOD: An experimental biomechanical investigation using six component sensors was conducted. Forces and moments in all three dimensions were measured, and conventional steel and nickel titanium palatal arches were compared with the compound palatal arch. Translations, rotations, torque, and specific combinations of movements were measured. The data were analysed using a specially designed computer programme. Throughout the experiments, the test apparatus was maintained in a controlled environment at 37°C.
RESULTS: There was no difference between the palatal arches with transverse expansion. An expansion of 2–3 mm exerted a force of 2–3 N. Additional torque lead to an ideal M/F ratio of 10. The main difference between conventional and compound palatal arches related to derotation and unilateral distalization. Compound arches showed a derotational moment of up to 40 Nmm with an activation of up to 20 degrees. With the compound palatal arch a 30-degree rotation exerted a moment that lay below 15 Nmm, whilst still demonstrating typical superelastic characteristics. This favourable moment allowed unilateral distalization without overloading the teeth or producing other negative side-effects.
CONCLUSIONS: From the biomechanical point of view, the newly developed compound palatal arch is especially effective for derotating molars and unilateral molar distalization. The lower load-deflection rate permits larger activations whilst avoiding excessive and unphysiological forces and moments.

216 ASSESSMENT OF THE USE OF AESTHETIC INDICATORS BEFORE AND AFTER ORTHODONTIC TREATMENT

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AIM: To evaluate the necessity of using aesthetic indicators (parameters) in orthodontic diagnosis and treatment (extraction and non-extraction).
SUBJECTS AND METHOD: Forty patients (24 females, 16 males), aged 13–26 years, before and after orthodontic treatment. The records comprised plaster models, photographs, cephalograms, and panoramic radiographs. The photographs and lateral cephalograms allowed analysis of all aesthetic changes, using aesthetic indicators (parameters) as: profile line, nasolabial angle, and labiomental angle. Computer cephalometric analysis (including Steiner analysis) JOE/RMO/ program was used in treatment planning. The data, including soft tissue aesthetic changes from the pre- and post-treatment cephalograms, were analysed and presented numerically and graphically. The group was divided according to gender, age, and method of treatment, extraction or non-extraction; females, 14 treated with extractions and 10 non-extraction; males, 11 treated with extractions and five non-extraction.
RESULTS: Pre-treatment soft tissue analysis, using aesthetic indicators, showed the necessity for aesthetic changes in 21 female and 12 male patients. No aesthetic changes were required in the other subjects. Computer cephalometric analysis determined the possibility and necessity of orthodontic treatment. After orthodontic treatment comparison of aesthetic measurements was carried out. There were differences in all cases. In 26 subjects occlusal changes were accompanied by favourable soft tissue aesthetic indicators, in four patients the occlusal changes were accompanied by unexpected and unfavourable soft tissue changes in spite of aesthetic measurement indications before treatment and in three occlusal changes resulted in poor or even worse facial aesthetics.
CONCLUSIONS: Aesthetic indicators are important tools in orthodontic treatment planning, but they have to be used with care in the assessment of facial aesthetics.

217 CHANGES IN THE SIZE OF WHITE SPOT LESIONS FOLLOWING FIXED APPLIANCE REMOVAL

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AIM: To use computerized analysis of images of post-orthodontic demineralized white spot enamel lesions to study the changes of size of these lesions, with and without a treatment regime.
SUBJECTS AND METHOD: Photographic images acquired under polarized light, with calibration, were converted to TIFF images and processed and measured by Image Pro-Plus software. Nineteen subjects with post-orthodontic white lesions were observed over 6 months after removal of their fixed appliances. In a randomized prospective controlled blind clinical trial, a further group of 21 orthodontic patients with post-treatment demineralized white lesions were assigned to either a test, 50 ppm NaF mouthrinse/toothpaste combination, or an inactive, fluoride-free control. The subjects were followed for a minimum of 6 months. Images of the lesions were acquired longitudinally and measured. In a separate study the group of 21 subjects from the clinical trial, who had intervention with either the active or non-active mouthrinse/toothpaste regime, were compared with the 19 observed non-intervention patients, who did not have such a regime.
RESULTS: Using a proportional outcome measure there was consistently a reduction in the size of post-orthodontic demineralized white spot lesions with time. For the observed group this change was highly significant after 26 weeks [from 8.1 per cent (SD = 3.7) to 3.5 per cent (SD = 2.1); $P < 0.003$]. The most rapid reduction occurred during the first 12 weeks after appliance removal. Little change occurred after 26 weeks. Subjects receiving the active mouthrinse/toothpaste showed no statistically significant difference in lesion size over the study period when compared with the controls. The subjects receiving the mouthrinse/toothpaste regime did show a statistically significant difference in lesion size ($P < 0.04$) when compared with the observed group acting as controls.
CONCLUSION: Post-orthodontic white spot lesions reduce in size in the 6 months following treatment. Intervention with a mouthrinse/toothpaste regime favourably affects the size of post-orthodontic white spot lesions. There is no clinical advantage in using the specific formulation of mouthrinse/toothpaste used in this study.

218 THE EFFECT OF INCISOR RETRACTION ON THE MAXILLARY ALVEOLAR PROCESS

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AIM: To investigate remodelling of the alveolar process following anterior tooth retraction.
SUBJECTS AND METHOD: Fifty-four subjects who had undergone premolar extractions and for whom cephalograms were available pre-treatment (T1), post-treatment (T2), and at follow-up (T3). The average age of the patients was 13.3 years, the mean treatment interval was 2.6 years, and the mean follow-up period 3.1 years. The lateral head films were traced on acetate by two assistant professors. The pre-treatment SN (SN1) was transferred to the T2 and T3 tracings by superimposition on stable cranial structure. Maxillary best-fit superimposition was used to evaluate the displacements of the upper incisor roots and remodelling of the alveolus. A constructed line parallel to SN1 through the centre of resistance (CRE) of the upper incisor was drawn. The remodelling of the alveolar bone anterior and posterior to the upper incisor root was measured at this level to evaluate the changes during and after orthodontic treatment.

The average of the two measurements was processed by the SPSS statistical package.
RESULTS: The CRE of the upper incisor moved backward 1.78 mm ($P < 0.001$) and upward 0.38 mm ($P > 0.05$) in the SN frame of reference during treatment. The post-treatment changes were not statistically significant. The width of the anterior alveolus at the same level increased 0.23 mm ($P < 0.01$) during treatment and relapsed 0.17 ($P < 0.05$) at the 3-year follow-up. The width of the posterior alveolus reduced 0.80 mm, which was significant ($P < 0.001$), during treatment and rebounded 0.01 mm ($P > 0.05$). The total width of alveolar process at the CRE level of the upper incisor reduced 0.91 mm, which was significant ($P < 0.001$) during treatment with almost no relapse occurring.
CONCLUSIONS: The absorption of the alveolus exceeds the apposition (if there is any) during upper incisor retraction and the reduced width of the alveolar process remains stable in the following years.

219 ROENTGENOGRAPHIC STUDY OF GROWTH OF THE MANDIBULAR CONDYLE OF TRABECULAR BONE

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AIM: To investigate mandibular samples using roentgenographic image analysis in terms of tooth age in order to clarify tendencies associated with growth and development.
MATERIALS AND METHOD: Five individual skulls (10 joints) were selected for each stage utilizing the Hellman's dental stage. Fifty specimens (100 hundred joints) consisting of dried human mandibles were evaluated. Frontal view images of the specimens were obtained with a CCD-TV camera. Following the application of shading compensation methods, the final measurement image was acquired with a binary code, from which trabecular bone was measured. The measurements obtained included total area, total perimeter number, area of each trabecular bone, perimeter of each trabecular bone, length alone, the major and minor axes, bone trabecular length along the *y*- and *x*-axes, mean trabecular length (ML), inclination angle of trabecular bone maximum length, and MBC.
RESULT: Growth of trabecular bone was classified into the following growth curves: a single major growth period, two major growth periods, and a pattern that did not belong to either group. The total area and total perimeter of trabecular bone and BMS indicated two major growth periods. Bone trabecular number and ML did not belong in either group. The remaining parameters indicated a single major growth period.
CONCLUSION: Development of trabecular bone was highly correlated with BMC; however, trabeculae did not exhibit identical developmental patterns. Development of trabecular bone progressed rapidly until around the time of tooth formation (masticatory function formation), following which growth continued, albeit slowly.

220 GROWTH PREDICTION USING GROWTH HORMONE IN SALIVA

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AIM: Growth prediction is important in orthodontic treatment. Whilst the Tanner–Whitehouse 2 (TW2) method using hand–wrist radiographs is one effective method, radiation is unavoidable. In order to establish an improved method for growth prediction, the relationship between some growth factor levels, including human growth hormone (hGH) in saliva, and conventional methods, such as hand–wrist radiographs and annual increases in body height instead of radiation or blood, were investigated.
SUBJECTS AND METHODS: Several growth factors in human saliva were measured in 10 Japanese females ranging in age from 6.8 to 11.8 years at the first examination. Seven subjects were diagnosed as skeletal Class III (ANB: –1.5 to 3.2) and three as skeletal Class I (ANB: 2.7 to 4.4). The levels of hGH, IGF-I, oestrogen, progesterone, and leptin were measured at the initial examination. Cephalograms, hand–wrist radiographs, and records of body height were taken at the same time. The relationship between these parameters was statistically measured.
RESULTS: IGF-I, oestrogen, and progesterone in human saliva were not detectable, while hGH was measurable. There was no significant relationship between hGH level and the craniofacial skeletal patterns. There was a significant relationship between hGH level and annual increase in body height.
CONCLUSION: Measurement of hGH in saliva might be useful for assessment of the growth stage of individual patients.

221 MORPHO-FUNCTIONAL FINDINGS IN ORTHOGNATHIC SURGERY

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AIM: To demonstrate the morphological and functional changes during pre-surgical treatment and 1 year post-surgically.
SUBJECTS AND METHOD: Fifty-six patients from a group of 153 subjects who underwent a sagittal split ramus osteotomy were selected because of the presence of all records. Pressureless impressions were taken followed by registration of centric relation. Additionally computer registration of the mobility of the lower arch was carried out (Zebris®, Zebris Medizintechnik, Isny, Germany). Mounting of the casts was undertaken in a Girrbach Reference-I-articulator. A manually based screening procedure (Kopp and Sebald, 1999) was used to evaluate the functional status of the craniomandibular (CMS) and cranio-cervical (CCS) systems. Statistical calculations were carried out with SPSS (version 10.5.2, SPSS Inc.).

RESULTS: There was a statistically significant change in mouth opening post-surgery in the Class II subjects and the recall Class III patients. Passive mobility changed pre-surgery ($P = 0.01$) in the Class II and III patients and in the recall Class II patients. A number of statistically noteworthy findings were seen in testing the musculature isometrically and by executing joint-play techniques, as well as dynamic tests in evaluating problems of the temporomandibular joints.
CONCLUSIONS: Evaluation of both morphological and functional parameters in orthognathic surgery patients should be executed systematically. Functional screening in the way described should be used as a diagnostic standard in orthognathic patients.

222 EFFECTS OF MECHANICAL STIMULATION ON RAT ORAL EPITHELIAL CELL KINETICS

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AIM: To estimate the proliferative response and cell cycle duration in rat oral epithelial cells in steady-state conditions and under the condition of sustained mechanical stimulation.
MATERIAL AND METHODS: Elastics (0.5 mm thick) were inserted between maxillary M1 and M2 of 8-week-old male rats that were labelled with H^3-TdR (S.A. 25Ci/mmol, 1 μCi/g body weight) and killed in groups of six or seven animals together with equal-sized groups of labelled control animals at intervals between 1 and 168 hours. Autoradiographs of consecutive mesio-distal sections were used to determine total grain counts for H^3-TdR-labelled cells in the basal (BL) and suprabasal (SL) cell layers of the palatal (PE), oral sulcular (OE), and junctional (JE) epithelia in the area of the dentogingival junction on the pressure side mesial to M1. The median cell cycle times (MCC) for all three cell populations were estimated from plots of mean and median grain counts against time (Fried, 1968).
RESULTS: Under steady-state conditions, MCC for PE, OE, and JE cells were 39, 14, and 9 hours, respectively. Mechanical stimulation caused a slower rate of reduction of total grain counts relative to controls in all layers of PE, basal layers of OE and JE as well as an increase of estimated MCC to 48, 44, and 34 hours in PE, OE, and JE cells, respectively.
CONCLUSION: Mechanical stimulation of the dentogingival junction on the pressure side induces slower progression of oral epithelial cells through the cell cycle.

Fried J 1968 Estimating the median generation time of proliferating cell systems in steady state. Biophysical Journal 8: 710–729

223 VALIDITY OF TOOTH-SIZE AND ARCH WIDTH MEASUREMENTS ON CONVENTIONAL AND VIRTUAL MODELS

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AIM: To test the accuracy of measuring casts with the aid of callipers or OrthoCad, and to compare these two techniques.
MATERIAL AND METHOD: Twenty set-ups using artificial teeth corresponding to various malocclusions were created. Impressions were taken from the set-ups, providing 20 plaster and 20 three-dimensional (3D) virtual orthodontic models. Measurements of mesiodistal tooth dimension, as well as upper and lower intercanine and intermolar widths were made on both models. Additionally the values of the mesiodistal tooth width were calculated from the isolated artificial teeth removed from the set-ups, and of the corresponding arch widths from the existing set-ups. The data of tooth size were divided and investigated according to four groups: incisors, canines, premolars, and molars. The resulting values were compared using non-parametric statistics. Random and systematic method errors were also calculated.
RESULTS: The methods were highly valid and reproducible for both tooth size and arch width. For the tested clinically applicable methods, measurement with digital callipers on plaster models showed the highest accuracy and reproducibility, closely followed by OrthoCad.
CONCLUSIONS: Measurement with digital callipers on plaster models produces the most accurate and reproducible results. The OrthoCad measurement tool shows high accuracy and reproducibility, but is inferior to measurements undertaken on plaster models with digital callipers. Digital callipers seem to be a more suitable instrument for scientific work. However, the accuracy of OrthoCad is clinically acceptable. Considering its present advantages and future possibilities, the examined, or an equivalent 3D virtual model procedure, may become the standard for orthodontic clinical use.

224 FORCED ERUPTION TEETH WITH A POOR PROGNOSIS AND IMPLANT SITE DEVELOPMENT: BENEFITS AND LIMITS

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AIM: Orthodontic extrusion of teeth with a poor prognosis is considered a reliable technique to enhance the topography of hard and soft tissues in the site of a future implant, provided at least one-quarter to one-third of the apical attachment is intact. The aim of this investigation was to identify the effective threshold for this procedure.
MATERIALS AND METHOD: Nine teeth from seven patients with advanced periodontal attachment loss were treated by extrusion. Five had supportive therapy that included scaling and root planning every 3 months. Bleeding

on probing and clinical probing depths greater than 3 mm was not found at the start of treatment. In two teeth, the periodontal defects almost approached the apex and less than 2 mm of bone support was present. Two patients had suffered maxillary incisor trauma at an early age. Crestal bone around the teeth was estimated by parallel-technique radiographs before and after orthodontic treatment. Extrusive arches were inserted. The mean extrusion time was 6 months.

RESULTS: Enhancement of the recipient site was achieved in all subjects when the apical residual attachment was healthy. No bone growth was detected around one tooth where repeated abscesses occurred during treatment. The regenerated crest was extremely thin, less than 2 mm, when the periodontal defects reached the apex. Satisfactory bone growth was obtained around another tooth, whose attachment loss was beyond the apex on the facial aspect of the root, but several millimetres of healthy periodontium remained on its other aspects.

CONCLUSION: Good enhancement of a recipient site can be obtained by extrusion if residual attachment is healthy. An extremely reduced residual attachment can also be associated with vertical growth, but an exceedingly narrow bone crest may result. If the attachment loss reaches the apical portion on one side of the root, residual attachment on the other surfaces can satisfactorily regenerate bone.