ABSTRACTS

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1 A FAMILIAL STUDY OF CRANIO-FACIAL SIZE

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AIM: To investigate the hereditary influence of craniofacial size.
SUBJECTS: One hundred and nineteen Japanese subjects (39 male, 80 female) who had completed growth, and their parents.
METHODS: Lateral and frontal cephalograms were taken and nine dimensions representing depth, width, height of the cranium, maxilla, and mandible were obtained from the 21 landmarks digitized. Correlation analyses between the subjects and their parents were performed concerning depth, width, height, and the product of the three dimensions of the cranium, maxilla, and mandible.
RESULTS: Eleven were significant in 12 correlation coefficients between male offspring and father, from 0.186 to 0.404. Two were significant between male offspring and mother, from 0.196 to 0.461 and nine were significant between female offspring and father, from 0.229 to 0.459. All 12 coefficients were significant between female offspring and mother, from 0.288 to 0.481.
CONCLUSIONS: 1. The relationships between father and offspring were higher than those between mother and offspring. 2. Female offspring showed a higher relationship with their parents than male offspring. 3. A systematic difference of heritability was not found among cranial, maxillary, and mandibular dimensions.

2 CLINICAL MANAGEMENT AND HISTOLOGICAL RELATIONSHIPS IN ORTHODONTIC LOADED PALATAL IMPLANTS

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AIM: To present the relationships between clinical management, radiographic and histology evaluations of endosteal palatal implants for solving anchorage problems during orthodontic therapy.
SUBJECTS AND METHOD: Fifty patients who were orthodontically treated and where anchorage was solved with the use of a palatal implant. In subjects with premolar extractions following retrusion of the anterior segment, or in those with distalization of lateral teeth, palatal implants were used for orthodontic anchorage instead of extra-oral appliances e.g. headgear. Histology, electron microscopic and radiographic evaluations were made and correlated with clinical observations and also with principles from biomechanical investigations. Different superstructures were analysed: 1. a cast palatal arch soldered to premolar orthodontic bands; 2. as No. 1 but with palatal side adhesive to the first premolars; 3. a bent half-profile arch with a prefabricated implant attachment.
RESULTS: At the beginning of the investigations a clinical loss of anchorage was observed and the rate of implant-loss before any orthodontic load increased up to 15 per cent. After transferring biomechanical results concerning palatal implant position and load to clinical procedures, the peri-implant attained more stability. Especially in subjects with distalization of molars, the clinical and histological situation showed sufficient bone stability around the inserted implants.
DISCUSSION: The comparison of clinical, radiographic and histology evaluations, including case presentations, were helpful in achieving effective clinical use of endosteal palatal implants for orthodontic anchorage.

3 EFFECT OF MECHANICAL STRESS ON THE EXPRESSION OF mRNAs ENCODING FOR α AND β CHAIN INTEGRINS, MMPS AND TIMPS IN HUMAN PERIODONTAL AND HUMAN GINGIVAL FIBROBLASTS

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AIM: The relationship between different cells constituting the periodontal ligament (PDL) and the periodontal alveolar bone is crucial in the understanding of tooth movement following orthodontic treatment. Tooth movement results from the applied mechanical strain and relies on various biological processes, such as the remodelling potential of the PDL and of the ability of periodontal cells i.e. gingival fibroblasts to synthesize enzymes responsible for the extracellular matrix degradation (Matrix Metalloproteinases or MMPs). Integrins are transmembrane heterodimers involved in many biological functions such as interactions with various extracellular matrix components (ECM) or cell to cell interactions. They mediate a variety of signalling cascades and are potent candidates to transduce mechanical stimuli into biochemical signals. To contribute to the understanding of the signal pathway initiated by integrins, a semi-quantitative RT-PCR was used to investigate the expression patterns of mRNAs encoding for α and β chain integrins as well as for MMPs and their inhibitors (TIMPs) in human gingival fibroblasts (HGF) and human PDL-fibroblasts after mechanical stretch compared with control cells.
MATERIALS AND METHOD: Both HGF and PDL-fibroblasts were cultivated on Petri dishes, with an untreated flexible bottom, and stimulated by the application of a constant strain (0.2 mBar during 12 hours) using the Flexercell strain apparatus.
RESULTS: Immunolocalization of vinculin and vimentin in stretched cells indicated an alteration of cell morphology, a re-organization of the cytoskeleton fibres and a redistribution of focal contacts. With the use of RT-PCR, a 3-fold increase in the expression of the mRNAs encoding MMP-1 in both cell types was observed, while mRNAs for other MMPs did not vary (MMP-2 and MTI-MMP), or were not expressed

(MMP-9). The main induction (>10-fold) was obtained with the mRNAs for TIMP-1 and TIMP-2 (inhibitors of the MMPs) while mRNA encoding TIMP-3 did not change. In the two cell types, the expression of the mRNA for β4 was not found although the mRNAs levels for α2 and β3 increased, the mRNA level for α3 decreased and those for α6 and ß1 did not vary. The main difference observed between the two cell types was a decrease in the mRNA for αv in PDL-fibroblasts, while no expression was found in HGF, and an expression of mRNA for α4 only in PDL-fibroblasts without variation relative to control cells.
CONCLUSIONS: These results indicate that HGF and PDL-fibroblasts induce similarly mRNA expression for MMP-1, TIMP-1 and TIMP-2 to contribute to the ECM remodelling process in response to mechanical strain but express different integrin profiles suggesting distinct biological responses within each cell type.

4 THE SIDE-EFFECTS OF RAPID MAXILLARY EXPANSION ON THE WIDTH OF THE MANDIBULAR ARCH

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AIM: Evaluation of the effects of rapid maxillary expansion (RME) appliances on the width of the mandibular arch.
SUBJECTS: Seventeen patients requiring RME.
METHODS: The average age of the patients was 9–17 years and the average activation interval was 27 days. Fourteen patients were treated with a Hyrax appliance and three with a Hass appliance. Study models were obtained before and after the end of the active phase of treatment. To evaluate the width of the lower dental arch, three reference points were marked on the study models at the crown, cervical line and 4-mm lower than cervical line on the buccal alveolar mucosa. The pre- and post-treatment difference between inter-molar and inter-canine width was evaluated.
RESULTS: There was a significant difference in the coronal inter-molar width (mean 0.42 mm, $P < 0.005$), but no significant difference between the coronal inter-canine width. There was a significant difference in the cervical inter-molar and inter-canine width ($P < 0.01$) and in the alveolar inter-canine width ($P < 0.01$), but not in the alveolar inter-molar width.
CONCLUSION: An increase in the width of the mandibular arch was evident. This effect is beneficial for some patients but if it is not required, other procedures are needed to prevent this type of side-effect.

5 DOES THE ORTHOPANTOMOGRAM ALLOW AN ASSESSMENT OF VERTICAL GROWTH AND TREATMENT CHANGES?

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AIM: To assess the reliability of an orthopantomographic analysis of vertical dentoalveolar and skeletal parameters.
MATERIALS AND METHOD: Orthopantomograms and lateral headfilms of 30 patients taken on the same day, both before and after an average treatment period of 2.5 years, were analysed metrically.
RESULTS: Comparison of the different measurements obtained from the orthopantomograms and the lateral headfilms revealed a moderate to high (r = 0.50–0.90) statistically significant correlation. However, when comparing the analysed growth and treatment changes only the anterior facial height, the anterior mandibular and posterior maxillary alveolar heights and the vertical position of the mandibular molar and maxillary incisor showed moderate correlations (r = 0.43–0.56).
CONCLUSION: An orthopantomographic analysis of vertical dentoalveolar and skeletal growth and treatment changes is not reliable.

6 RELIABILITY OF A NEW IMAGE ANALYSIS TECHNIQUE IN ORTHODONTIC RESEARCH

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AIM: To determine the reliability of a new image analysis system.
MATERIALS: Twenty sets of dental casts of white Caucasian subjects.
METHODS: Images of teeth were acquired by one investigator when the cast was positioned on a calibrated stage using a digital camera for analysis. Reproducibility of measurements was undertaken by four investigators to evaluate the accuracy of measuring the acquired image. This was determined by comparing the mesiodistal (MD) and buccolingual (BL) dimensions, area and perimeter, from buccal and occlusal views on two separate occasions. The upper central incisors (N = 20), canines (N = 18) and first molars (N = 20) were re-imaged by one investigator and remeasured to assess total systematic errors, by comparing MD and BL diameters from the two occasions for the image analysis and standard manual techniques.
RESULTS: Calculated limits of agreement (Altman, 1991) for intra-investigator reproducibility showed that the average agreement within investigators ranged from 1.7 to 2.9 per cent of a typical tooth type measurement for buccal view images and 1.6–2.6 per cent for the occlusal view images; average inter-investigator assessment was greater, with ranges of 7.4–8 and 6.8–7.6 per cent for both views, respectively. Imaging repeatability by one operator showed no significant differences (95 per cent level) between tooth types or between total errors of the manual and image analysis techniques for any of the measurements on teeth in both views.
CONCLUSION: The new system is reliable. The additional advantage of the system is that it provides far more information concerning tooth dimensions and morphology than standard manual techniques, thus increasing discrimination in comparisons between groups in clinical and aetiological studies of orthodontic patients.

Altman D G 1991 Practical statistics for medical research, pp. 398–403

7 LEVELLING THE CURVE OF SPEE WITH ROUND COMPARED WITH RECTANGULAR ARCHWIRES

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AIM: To study the effects of full continuous archwires, rectangular in cross section, on the axial inclination of lower incisors during levelling of the curve of Spee.
SUBJECTS: Twenty-eight adolescent and adult patients from the Department of Orthodontics, University of Illinois. All patients had a full complement of permanent teeth with slight crowding or spacing (3 mm), a deep overbite and a deep curve of Spee, treated with continuous archwire mechanics.
METHODS: The patients were randomly assigned to two groups. Group 1 (N = 12) received round archwires and group 2 (N = 16) started with flat 0.016 × 0.022 inch nickel titanium archwires progressing to a 0.016 × 0.022 inch stainless steel. A lateral cephalometric radiograph and a mandibular study model were taken before treatment (T1) and when the curve of Spee was levelled, or when the overbite was considered clinically acceptable (T2).
RESULTS: Statistical analysis (*t*-test) showed no significant difference between the two groups. Correlation coefficient analysis demonstrated a significant correlation between lower incisor proclination and change in inter-canine width and relief of crowding.
CONCLUSION: The ability to control the axial inclination of the lower incisor with a rectangular archwire was not supported.

8 COMPARISON OF CONDYLAR PATHS AND ARTICULATOR GENERATED CONDYLAR POSITIONS IN DEEP AND OPEN BITE SUBJECTS WITH HEALTHY TEMPOROMANDIBULAR JOINTS

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AIM: To determine condylar paths and differences between CR/CO in deep and open bite subjects who are traditionally thought to be prone to temporomandibular dysfunction (TMD).
SUBJECTS: One control group (CG) with normal overbite, and two study groups, deep bite (DBG) and anterior open bite (OBG), each consisting of 30 young adult volunteers, with full dentitions and without TMD symptoms or any potential occlusal aetiological factor other than the type of incisal guidance.
METHODS: Sagittal plane axiographic tracings, and wax bite records in centric relation (CR), using the bilateral manipulation technique, and habitual occlusion (CO) were obtained for each subject. Models were mounted on a SAM 3 articulator in CR, and three-dimensional CR/CO differences were measured using the mandibular position indicator.
RESULTS: The mean direction of the condyles when moving from CR to CO was antero-inferior with more condyles in the CG moving straight anteriorly. There were no other statistically significant differences among the three groups when comparing the amount or direction of CR/CO change, with the greatest variability always in the OBG. Of all the condyles only 7 per cent moved ≤ 2 mm in the sagittal plane and 20 per cent moved ≤ 1 mm in the transverse plane. Axiographic tracings also showed no significant differences between groups for opening and protrusion angles (total mean 49 and 53 degrees, respectively) and distances (total mean 13 and 10 mm, respectively) except for a decrease in the OBG and an increase in the DBG in protrusion distances.
CONCLUSION: These data provide no evidence of an increased risk of TMD due only to bite depth when other occlusal variables are controlled.

9 THE EFFECT OF LIP BUMPER TREATMENT IN THE CO-ORDINATED ARCH DEVELOPMENT TECHNIQUE

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AIM: A mandibular lip bumper is widely used for arch development, but reports of its effect are varied owing to the construction of the appliance. The aim of this study was to investigate the effect of mandibular lip bumper treatment especially designed for the Co-ordinated Arch Development (CAD) technique.
SUBJECTS AND METHOD: Ten children in the late mixed and early permanent dentitions (Dental stage IIIB–IIIC). The lip bumper was fabricated from 0.045 inch wire without acrylic shields and a TP rotation molar tube (391-514/5). Activation was carried out once a month during treatment for 1–2 mm at the anterior teeth, 3–4 mm at the premolar region, and passive at the buccal wall of the first molar tube. The tooth movements and the changes of facial skeleton were studied three-dimensionally using dental casts, cephalograms and self-developed occlusogram software.
RESULTS: After an average treatment period of 12 months, labial tipping of the lower incisors and distal uprighting of the lower first molars were observed from cephalometric analysis. Dental cast analysis showed that the amount of crowding was decreased 6.2 mm, and that the molar width was expanded 7.4 mm. Occlusogram analysis revealed that three-dimensional arch development, sagittal and transverse uprighting and distal rotation were obtained even in the premolar area.
CONCLUSIONS: The results suggest that the lip bumper design for the CAD technique is very effective for arch development.

10 CLINICAL CHARACTERISTICS OF FAMILIES WITH HYPODONTIA

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AIM: To evaluate the variation of hypodontia and dental features in Finnish families where incisor-premolar hypodontia is inherited as an autosomal dominant trait with incomplete penetrance.
SUBJECTS AND METHODS: Eleven hypodontia patients and their first- and second-degree relatives, 204 individuals of 11 families were examined. Panoramic radiographs were taken, and retrospective data were collected from dental files. The pedigrees of 11 probands were constructed, and dental features analysed in these pedigrees. The prevalence of dental anomalies was compared with the population prevalence.
RESULTS: The mean number of missing teeth was 2.3 in the probands and 1.5 in the first- and second-degree relatives, the teeth most frequently missing were second premolars and upper lateral incisors. In addition, two (18 per cent) of the probands, four (8 per cent) and seven (11 per cent) of the first- and second-degree relatives had peg-shaped upper lateral incisor(s). Six (55 per cent) of the probands and 20/59 (34 per cent) of the relatives, inherited hypodontia from their mother and five (45 per cent) and 17/59 (28.8 per cent) from their father. Hypodontia was observed in 19 (43 per cent) of the first-degree relatives and in 20 (33 per cent) of the second-degree relatives, which is 4–5 greater than the population prevalence. The most frequent dental abnormality associated with hypodontia in these families was taurodontism. Seven (64 per cent) of the probands showed taurodontism of one or more molars. Taurodontism was observed in 3/16 (18.8 per cent) of the first-degree relatives with hypodontia and in 4/18 (22.2 per cent) of second-degree relatives. Taurodontism of upper molar was more common both in probands and family members.
CONCLUSION: From this study, it can be concluded that it is important to carry out screening for hypodontia and related dental abnormalities in children of families with hypodontia. Early diagnosis allows planning of the best possible guidance and treatment for the developing occlusion.

11 ACTIN POLYMERIZATION IN PERMEABILIZED HUMAN GINGIVAL FIBROBLASTS

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AIM: In order that the fibroblast actin cytoskeleton and the process of stress fibre regulation can be further examined, a qualitative assessment of the polymerization of actin in human gingival fibroblasts (HGF) was undertaken following permeabilization.
MATERIAL: HGF grown in cell culture between the third and the eighth passage.
METHODS: In a series of controlled experiments, HGF, counted by a haemocytometer, were plated at 2×10^6 per dish under sterile conditions 24 hours before each experiment. Stress fibre formation was induced (Ridley and Hall, 1992) by 2 μM lysophosphatidic acid (LPA). Cells were permeabilized by 0.003 per cent digitonin (Mackay *et al*., 1997). F-actin formation was measured by a fluorometric assay to measure the displacement of TRITC-phalloidin (Heacock and Bamburg, 1983) calibrated against a standard curve of DNA (Brunk *et al*., 1979). In a separate set of controlled experiments, F- and G-actin pools were separated by ultra-centrifugation at 1×10^6 g.
RESULTS: The fluorometric assay showed that 2 μM LPA for 15 minutes generated optimum levels of F-actin in non-permeabilized HGF. Permeabilized HGF stimulated by 2 μM LPA produced F-actin but in a smaller quantity than non-permeabilized HGF. Separating the actin pools produced pellets of actin that were smaller in those experimental protocols with permeabilization.
CONCLUSION: HGF can be permeabilized with digitonin and the filamentous actin of their cytoskeleton can be increased using LPA. This model system will allow further study of the mechanisms of cytoskeleton remodelling of HGF.

12 THE APNOEA-HYPOPNOEA INDEX: DOES IT CORRELATE WITH CEPHALOMETRIC VARIABLES?

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AIM: To test in patients with sleep disordered breathing whether the apnoea-hypopnoea index (AHI) was correlated with skeletal or pharyngeal soft tissue variables. Considering the critical role of body mass index (BMI) in sleep apnoea syndrome, patients with a BMI less than 30 or greater than 30 were treated separately.
PATIENTS: Sixty one non-obese and 83 obese male patients of the Europoid type aged 45–65 years with good dental support. AHI was respectively 56 ± 28 and 75 ± 36 in the two groups.
METHOD: Twelve cephalometric skeletal variables and seven pharyngeal soft tissue measurements were used. Paired *t*-tests and correlation coefficients were calculated and a regression analysis was conducted.
RESULTS: When compared with the obese group, the non-obese group showed reduced AHI ($P = 0.00$), ArGn ($P = 0.02$), tongue length ($P = 0.00$) and reduced distance from the posterior wall of the pharynx to the symphysis ($P = 0.00$). In the non-obese group AHI correlated with the pharyngeal elongation H-Pns ($r = 0.43$, $P = 0.00$), the distance from hyoid bone to the NT ($r = 0.47$, $P = 0.00$), the distance between H′ (the projection of hyoid bone on MP) and point Menton ($r = 0.27$, $P = 0.00$), the distance from the posterior

wall of the pharynx to the symphysis (r = 0.37, P = 0.00). These variables accounted for only 26.95 per cent of the variance of AHI. In the obese group AHI correlated with BMI (r = 0.32, P = 0.00), soft palate length (r = 0.27, P = 0.01) and H′Me (r = –0.26, P = 0.02) accounting for 31.85 per cent of the total variance of AHI.
CONCLUSIONS: The pharyngeal configuration, the position of the chin and the length of the soft palate show some degree of correlation with AHI. However, cephalometric variables seem to be only poor predictors of AHI. Other specific functional variables are probably required to explain AHI variations. The role of weight in AHI appears to become critical with BMI greater than 30.

13 'EFFECTIVE' TEMPOROMANDIBULAR AND CHIN CHANGES DURING ACTIVATOR TREATMENT

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AIM: To assess the amount and direction of 'effective' temporomandibular joint (TMJ) and chin changes during activator treatment of Class II malocclusions.
MATERIAL: Lateral head films of 40 Class II division 1 patients treated successfully with an activator. The radiographs were taken before and after an average treatment period of 2.6 years. A group of untreated subjects with ideal occlusion (Bolton standards) was used for comparison.
METHOD: The cephalograms from pre- and post-treatment were evaluated by means of a modified method of Creekmore (1967). Two different treatment effects were evaluated: (1) Total treatment effect and (2) Net treatment effects (Total treatment effect minus age-related Bolton-value).
RESULTS: The comparison between the activator and the Bolton group revealed only a slight increase in 'effective' TMJ and chin changes by activator therapy. The direction of change in the activator patients was more vertically orientated compared with the Bolton group.
CONCLUSION: The 'effective' TMJ and chin changes were increased by activator therapy, although not in the desired (sagittal) therapeutic direction.

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

14 FIELD SIZE REDUCTION IN LATERAL CEPHALOGRAMS FOR CHILDREN YOUNGER THAN 12 YEARS OF AGE

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INTRODUCTION AND AIM: In orthodontic treatment lateral cephalograms are necessary for treatment planning and therapy monitoring. For many years high intensifying screen/film combinations were the preferred choice for radiation dose reduction. A further reduction can be realized by minimizing the X-ray field size. The aim of this investigation was to determine the smallest necessary diagnostic field size for lateral cephalograms in orthodontics without loss of information.
MATERIAL AND METHODS: Two hundred lateral cephalograms (focus film distance 4 m, Cephalostat Siemens, Germany) from children younger than 12 years (96 males, 104 females, aged 7.4–11.8 years), 90 lateral cephalograms (focus film distance 1.5 m (Orthopantomograph 5, Siemens), 38 males, 52 females aged 7.5–12.1 years were measured to evaluate the smallest necessary diagnostic field size. The limitation points which must be included in the radiation field for orthodontic purposes are cranial: sella and nasion; caudal: soft tissue menton and cervical point; ventral: soft tissue nose; dorsal: basion and porion. In addition to the cervical spine (vertebral body 2–6) parts of the osteocranium were also blocked out because all commonly used cephalometric analyses do not use landmarks in this areas.
RESULTS: In all 200 measured cephalograms with a focus film distance of 4 m a field size of 14 × 14 cm included all determined landmarks in addition to a safety area of 0.5 cm. In 199 radiographs even a smaller field size was sufficient. Only one patient needed 14 cm in a horizontal direction. Ninety cephalograms with the focus film distance of 1.5 m field size 14 × 14 cm did not cover all necessary landmarks. Twenty five patients needed a larger film size (11 patients in a vertical direction, 9 patients in a horizontal direction and 5 patients in both directions). For all cephalograms with a focus film distance of 1.5 m, a field size of 15 × 15 cm was sufficient.
CONCLUSIONS: A 50 per cent reduction of field size using a focus film distance of 4 m, and 48 per cent reduction of film size using a film focus distance of 1.5 m, is possible without loss of diagnostic information.

15 CEPHALOMETRIC COMPARISONS OF SUBJECTS WITH SNORING AND OBSTRUCTIVE SLEEP APNOEA

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AIM: To investigate the differences in skeletal, oral and pharyngeal morphology between simple snorers, subjects with obstructive sleep apnoea (OSA), and non-snoring controls.
MATERIALS: Upright lateral cephalograms of 115 dentate, adult, Caucasian males were examined. Forty six were snorers, 45 subjects exhibited OSA and 24 individuals with no history of snoring, acted as controls. The diagnosis of OSA or simple snoring had been confirmed by polysomnography.
METHOD: Radiographs were traced and digitized and an analysis of variance compared the dento-skeletal, soft

tissue and oro-pharyngeal measurements of each group, controlling for age and body mass index (BMI). All measurements were corrected for magnification.
RESULTS: The mean ages and BMIs of the OSA and snoring groups were comparable but the control group was both younger and leaner. Cranial base angle, mandibular body length and intermaxillary space length in the snoring and OSA groups were similar and significantly smaller than those of the controls at the 5 per cent level or better. The same held true for the dimensions of the airway and associated structures. Both snorers and OSAs had narrower airways, reduced oropharyngeal areas, shorter, thicker soft palates and larger tongues than the controls. Comparison of the two sleep disordered breathing groups revealed significant soft tissue differences: in OSA subjects the soft palate ($P < 0.05$), lingual ($P < 0.01$) and oropharyngeal ($P < 0.05$) areas were increased and the hyoid was lower in relation to the mandibular plane ($P < 0.05$).
CONCLUSIONS: 1) Although the dento-skeletal patterns of snorers resembled those of OSA subjects, differences in soft tissue and hyoid orientation were seen. 2) There was no recognizable gradation in size in the airway and its associated structures from control through snoring to OSA subjects. There may be a cephalometrically recognizable predisposition towards the development of sleep disordered breathing but this is only one facet of the condition. 3) It is important to take a respiratory history from potential control subjects: if snoring subjects are recruited, significant differences may be obscured.

16 THE EFFECT OF HERITABILITY ON BOLTON TOOTH-SIZE RATIO

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AIM: To determine the effect of heritability on Bolton tooth-size ratio.
MATERIAL: Dental casts of 103 siblings, 52 females and 51 males, with no bilateral tooth loss in the permanent dentition.
METHOD: The sibling pairs were sub-divided. The mesio-distal crown widths of incisors, canines, premolars, and first molars were measured on each of the casts. Overall and anterior ratios were calculated. The heritability (h^2) was calculated from the intraclass correlation as $h^2 = 2r$. The effect of sex was evaluated by means of a one-way analysis of variance.
RESULTS: The heritability estimate values of overall and anterior ratios were found as 0.627 ± 0.249 and 0.651 ± 0.250, respectively. This result indicates that overall and anterior ratios are affected by hereditary factors at a statistically significant level.
CONCLUSION: Because of the high heritability, Bolton's tooth-size discrepancy should be considered in the treatment planning for children whose parents have any orthodontic malocclusion.

17 TREATMENT EFFECTS WITH THE HEADGEAR ACTIVATOR

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AIMS: To investigate the sagittal treatment effects with the headgear activator.
MATERIAL: Cephalograms from 17 male patients with Class II division 1 malocclusions treated with a headgear activator obtained 6 months before, at the start, and after 6 and 12 months of treatment.
METHOD: Cephalometric analysis *ad modum* Pancherz (1982).
RESULTS: Restriction on maxillary forward growth was obtained after 6 months of treatment and remained the same at 12 months. There was no difference in mandibular forward growth during the observation period before treatment compared with 0–6 and 6–12 month periods of treatment. The incisor changes were not significant. The difference in change skeletal base (A-Pog) became highly significant after 12 months of treatment but was not significant after 6 months of treatment or during the observation period.
CONCLUSION: There is no treatment effect on mandibular forward growth in patients treated with the headgear activator. The change in basal relationship is due to restraint of the maxilla only.

18 VARIATION IN VERTICAL DIMENSION AFTER EXTRACTION THERAPY: AN INFERENTIAL STATISTICAL STUDY

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AIM: To evaluate cephalometrically and statistically the effect of extractions on the vertical dimensions in adult patients with Class II malocclusions.
MATERIAL: Lateral cephalometric radiographs obtained before and after treatment of 35 patients with Class II malocclusions treated with extraction of upper second and lower first premolars were cephalometrically analysed. Of the subjects 45.7 per cent were hypodivergent, 31.4 per cent normodivergent and 22.9 per cent hyperdivergent.
METHODS: For each patient the skeletal vertical dimension, dental vertical dimension and the skeletal divergence were considered pre- and post-treatment. A statistical analysis with Wilcoxon's test was used to evaluate modifications induced by the therapy.
RESULTS: All the skeletal and dental vertical dimension measurements increased in both the normo- and hypo-divergent groups, in the last group the modifications were highly significant. No statistically significant alterations were observed in the hyperdivergent group.
CONCLUSION: The results show that even in hypodivergent patients it is possible to obtain facial harmonization.

19 RELIABILITY OF POST-SURGICAL CEPHALOMETRIC MEASUREMENTS

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AIMS: To determine the reliability of cephalometric measurements in post-surgical studies.
MATERIAL: Two post-surgical cephalograms from 71 orthognathic surgery patients were superimposed and digitized. The time between the films was 9.8 (mean) respectively 11(median) months. Intra-operatively all patients had received additional screws near the osteosynthesis plates.
METHOD: Best-fit superimposition of radiographs on the anterior cranial base and the inner contour of the mandibular symphysis revealed post-surgical stability in 43 patients (mean age 23.9, median 23 years; minimum 16, maximum 42; 35 per cent male, 65 per cent female). Instability was assumed if the implanted screws deviated more than the combined effects of the errors of measurements and projection (28 patients). In all cases angular cephalometric measurements (SNA, SNB, SNPg, NL:NSL, ML:NSL) were performed.
RESULTS: In the 'stable' group the mean differences and standard deviations between the two serial headfilms were: SNA = mean 0.22 degrees, SD 2.79; SNB = mean 0.85 degrees, SD 2.30: SNPg = mean 0.96 degrees, SD 2.86; NL:NSL = mean 0.32 degrees, SD 2.37; NL:NSL = mean 0.46 degrees, SD 2.99. There were no statistically significant differences (Mann-Whitney *U*-test) between these patients and the 'unstable' ones (28 patients). In the 'stable' group a comparison between patients who received combined maxillary-mandibular osteotomies (11 cases) and those with only mandibular surgery (27) revealed no statistically significant differences (Kruskal-Wallis ANOVA). However in relation to performed surgery the 'unstable' cases showed statistically significant differences at the $P = 0.05$ level for SNB and SNPg-angle. Comparison of the groups of patients who received the same surgical procedure showed statistically significant differences only for the SNB angle ($P = 0.001$).
CONCLUSIONS: Standard cephalometric measurements are of low reliability to quantify post-surgical stability. This finding has a bearing on the confidence that can be placed on individual case analysis post-surgically.

20 A STUDY OF CRANIOFACIAL ASYMMETRIES USING THREE-DIMENSIONAL COMPUTED TOMOGRAPHY IN THREE-DIMENSIONAL VESTIBULAR ORIENTATION

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AIM: To obtain three-dimensional (3D) reconstructions and to define the vestibular orientation which represents an anatomical-physiological reality, enabling definition of a strict median line, essential for the study of craniofacial asymmetries in dentofacial orthopaedics.
MATERIAL AND METHODS: Computer tomographic (CT) scans of a patient with craniofacial asymmetry. The method consisted of determining the antero-posterior reference of the median sagittal plane, the medio-labyrinth plane and performing axial and frontal 3D reconstructions of the craniofacial mass in the vestibular orientation, passing through the nerve orifices of the fifth cranial nerve of the base of the skull and face. The medio-labyrinth axis was superimposed on each reconstruction, making a 3D CT cephalometric analysis possible on the basis of the fifth cranial nerve indicators.
RESULTS: The combination of the superimposition and the CT cephalometric analysis enabled the exact seat to be defined.
CONCLUSION: This method permits the study of craniofacial asymmetries rendered difficult by morphological anomalies, the production of teleradiographic films and the definition of a reference axis.

21 THE EFFECT OF MOUTH BREATHING ON PHYSICAL DEVELOPMENT AND MALOCCLUSIONS

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AIM: To estimate the correlation between mouth breathing, physical development and malocclusions.
SUBJECTS AND METHODS: Sixty four mouth breathing patients aged 6–11 years. Anamnestic, clinical and laryngological records were obtained. The correlation between mouth breathing, type of malocclusion and physical development based on parameters such as height, weight and chest measurement, were estimated.
RESULTS: It was found that 35.21 per cent of the subjects examined were mouth breathers and these patients had a slight retardation of physical development based on weight and height measurements. The parameter of chest measurement indicated enlargement in all groups, but statistically it was confirmed only in one group. The most often seen malocclusions in the examined children were distocclusions with protrusion of the upper incisors, constrictions of both dental arches and anterior open bites.
CONCLUSIONS: Mouth breathing is an important factor in the formation of malocclusions and is connected with a slight retardation of physical development. A slightly increased chest measurement could indicate an increased volume of air still left in the lungs (the residual volume—RV) caused by ventilation disturbances.

22 LOCATION OF THE CENTRE OF RESISTANCE OF THE UPPER DENTITION AND THE NASOMAXILLARY COMPLEX

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AIM: To investigate the initial displacement of the upper dentition and the nasomaxillary complex as a result of different directions of force application, and to determine

the initial centres of resistance for both the upper dentition and the nasomaxillary complex.
MATERIAL: A macerated human skull with well-aligned upper teeth was used as the experimental model. Araldit 208 was used as a substitute for the periodontal ligament. A specially designed 'antenna-headgear' was developed in an attempt to create different points of force application.
METHODS: Double exposure holography was used as the measuring technique. Reproducibility was tested and the technique was found to be reliable.
RESULTS: According to the registered fringe patterns, the following findings were noted: 1. The force application transmitted by the headgear resulted in complex orthopaedic displacement of facial bones. 2. Pure translation of the maxilla and the upper dentition was observed when the force vector passed by in the area of the key-ridge. 3. No obvious difference could be found between the centre of resistance of the upper dentition and the nasomaxillary complex.
CONCLUSION: The location of two different centres of resistance as suggested by Teuscher in activator headgear therapy could not be confirmed by measuring initial displacements on a macerated human skull.

23 SUTURAL OPENING IN SLOW AND RAPID PALATAL EXPANSION TREATED SUBJECTS

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AIM: Examination of dental and skeletal dimensional changes as the result of slow (SPE) and surgically-assisted rapid palatal expansion (RPE) treatment.
SUBJECTS: Twenty patients with individually made fixed banded Hyrax expanders took part in the study. Ten were treated with SPE and the other 10 patients with surgically-assisted RPE. Two sets of plaster models and two postero-anterior (p-a) radiographs per patient were used to show the situation pre-treatment and after six weeks of active expansion. Based on the p-a radiographs the skeletal changes could be evaluated.
METHODS: SPE was undertaken in subjects where the sutura palatina was not ossified. The activation of the screw followed an exact given procedure. In the surgically-assisted RPE subjects the screw was activated during surgery. Expansion was continued following a detailed treatment plan. Defined points were used to measure the anterior and posterior changes of the maxillary width. The p-a radiographs were analysed following the standard Münster procedure. The skeletal maxillary width and the skeletal width of the nose pre- and post-treatment were evaluated in relation to dental parameters.
CONCLUSION: In contrast to the literature, a significant difference was found with dental anterior compared with dental posterior expansion. The surgically-assisted RPE promotes a greater increase in dental anterior expansion. The skeletal changes on the radiographs showed a significant increase in the maxillary and nasal width.

24 BONE REGENERATION OF CALVARIAL DEFECTS USING GROWTH HORMONE AND POLYTETRAFLUOROETHYLENE MEMBRANES

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AIM: To evaluate the biomechanical properties of bone regeneration in calvarial defects covered with polytetrafluoroethylene membranes in rats when given systemic administration of growth hormone (GH).
MATERIALS AND METHOD: Forty 1-year-old Wistar rats were used in the study. Two full thickness bone defects, 5 mm in diameter, were trephined in the dorsal part of the parietal bone, lateral to the sagittal suture. The bone defects were covered with an exocranial expanded polytetrafluoroethylene membrane (Gore-Tex) placed between the periosteum and the parietal bone, and an endocranial membrane placed between the dura mater and the parietal bone. Twenty rats were injected subcutaneously with recombinant human GH (2.7 mg/kg/day) dissolved in sterile water (1.35 mg/ml), whereas the remaining 20 rats were injected subcutaneously with isotonic sodium chloride (0.5 ml/12 hours). The animals were killed 28 days after surgery. The biomechanical test was performed with a materials testing machine (Alwetron 250), by a modified punch out test procedure using a 33-mm diameter steel pin at a constant deflection speed (2 mm/min). The load was applied in the centre of the defect. Subsequently, the specimens were used to evaluate the tissue dry weight and the ash weight. Statistical analysis was performed by a Mann-Whitney *U*-test.
RESULTS: Ultimate load, ultimate stiffness and energy absorption at ultimate load were significantly higher in the GH group (35.4 N, 65 N/mm, 17.8 N*mm, respectively) than in the control group (14.1 N, 33 N/mm, 5.6 N*mm). Furthermore, tissue dry weight, ash weight and ash weight as a percentage of tissue dry weight were significantly higher in the GH group (8.3 mg, 4.9 mg, 59 per cent, respectively) than in the control group (2.9 mg, 1.4 mg, 48 per cent).
CONCLUSIONS: This study shows that GH administration, combined with osteopromotive membranes, enhances bone regeneration and mechanical properties of rat calvarial defects.

25 CHANGES IN CEPHALOMETRIC MEASUREMENTS IN ORTHOGNATHIC SURGERY PATIENTS BEFORE, DURING AND AFTER TREATMENT

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AIM: To determine the capability of cephalometric measurements to discriminate dentofacial changes due to orthodontic treatment and orthognathic surgery.

SUBJECTS: Sixteen subjects with skeletal Class II, 12 subjects with skeletal Class III and 11 subjects with skeletal open bite, all undergoing orthognathic surgery.
METHODS: Lateral cephalograms obtained before treatment (T1), after orthodontic decompensation (T2), and 24 months after surgery (T3). Twenty one standard measurements (e.g. SNA, SNB, ANB, Wits' appraisal, Björk's sum, ODI, APDI, overjet, overbite, upper incisor to S-N, lower incisor to MP) and Sato's Denture Frame Analysis, i.e. 16 measurements were used (AB-MP, OP-MP, OP-MP/PP-MP, inclination and protrusion of upper and lower incisors to A-B plane, SN-MP, PP-MP, FH-PP, FH-MP, distances A′6′ & A′P′ on the PP, A′6/A′P′, intermolar angle).
RESULTS: While 25 of 37 measurements showed significant differences between T2 and T3 ($P < 0.05$) in Class II subjects, there were only three standard measurements (overbite, ODI, protrusion lower incisor to N-Pg) and five Denture Frame measurements (AB-MP, OP-MP, PP-MP, inclination of upper incisor to A-B, protrusion of lower incisor to A-B) that yielded significant differences at T2–T3 and/or T1–T3 in all three groups (Classes II and III, open bite).
CONCLUSION: Combined cephalometric ODI and Denture Frame measurements enable critical discrimination of morphological changes of severe Class II, Class III and open bite dysgnathia during treatment.

26 COMPARISON OF THE EFFECTS OF ACTIVATOR AND CLASS II ELASTICS IN THE TREATMENT OF SKELETAL CLASS II RELATIONSHIPS AND OVERJET

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AIM: To compare the effects of activator and Class II elastics in the treatment of skeletal Class II relationships and overjet.
MATERIAL: Lateral cephalometric films from 30 patients with a skeletal Class II relationship. Fifteen were treated with an activator and 15 non-extraction with the edgewise technique and Class II elastics.
METHOD: Lateral cephalometric films were taken pre- and post-treatment. In order to determine a skeletal Class II relationship, ANB angle was taken as the criterion, and the patients whose ANB angle was larger than 5 degrees were selected for investigation. The patients were advised to wear the Class II elastics and activator at least 18 hours a day. In order to determine changes resulting from treatment in both groups, the measurements obtained pre- and post-treatment were compared with a paired *t*-test. A Student's *t*-test was used for comparing changes occurring in the activator and Class II elastic groups.
RESULTS: Statistical analysis showed that there were significant differences in both groups and more significant changes in the activator group were obtained.
CONCLUSION: In the correction of a skeletal Class II relationship, it was found that the activator was more effective than Class II elastics.

27 CELLS INVOLVED IN THE HEALING OF INTRAMEMBRANOUS BONE MIXED WITH DEMINERALIZED INTRAMEMBRANOUS BONE MATRIX

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AIM: To identify the cells involved in the healing of intramembranous (IM) bone grafts in the presence of demineralized intramembranous bone matrix (DBM_{IM}) and to compare it with the healing of autogenous IM bone grafts.
MATERIAL AND METHODS: Thirty-two defects were created in the skulls of 32 New Zealand White rabbits. Sixteen defects were grafted with IM bone alone and the other 16 defects with composite IM-DBM_{IM}. Eight rabbits, 16 defects, were used as controls, where eight defects were left empty (passive control) and the other eight defects were filled with rabbit skin collagen (active control). Tissues were retrieved on days 1, 2, 3, 4, 5, 6, 7 and 14 for cellular identification by light and electron microscopy.
RESULTS: Inflammatory cells (polymorphonuclear leukocytes) were present on days 1 and 2, which was similar to the autogenous group. In contrast, the appearance of the mesenchymal cells and pre-osteoblasts, osteoblasts and osteocytes was earlier (day 3) than in the healing of autogenous IM bone grafts (day 5). In both of the grafts, pre-osteoblasts, osteoblasts and osteocytes were observed with no intermediate cartilage stage.
CONCLUSION: Autogenous IM bone graft (as expected) and autogenous IM bone mixed with DBM_{IM} healed through an osteogenic ossification route. This allows earlier loading of implants which in turn reduces resorption of the newly formed bone.

28 STRESS DISTRIBUTION IN THE CHIN REGION FOLLOWING GENIOPLASTY

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AIM: To investigate the surgical simulation of soft tissue changes in the chin region and analyse the stress distribution following sliding genioplasty by using the three-dimensional (3D) finite element model (FEM) based on helical computed tomography.
MATERIAL: A synthetic rubber dummy, which had a real craniofacial bone structure, was used. Helical computed tomography (CT) was undertaken and 45 slices were used. A 3D-FEM, consisting of 56,587 nodes and 49,545 elements, was constructed. The model itself consisted of bone and soft tissue. Each material property was defined by Young's modulus and Poisson's ratio. The boundary conditions were fixed at the condyles of both sides. The nodes, corresponding with the bone segment of the genioplasty, were assumed to range within 5 mm high from the bottom of symphysis. Transformation and principal stress distribution charts were analysed.
RESULTS: A compressive stress was largely concentrated in the chin region, and covered the upper and lower

lip. The displacement ratio was distributed over the lower face.
CONCLUSION: These results suggest that simulation based on FEM is an effective expedient to visualize potential results.

29 THE TIMING OF ORTHODONTIC AND IMPLANT TREATMENT

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AIM: To identify the correct moment to intervene and plan orthodontic and implant treatment.
SUBJECTS: One hundred and eighty seven patients referred to the Department of Orthodontics, University of L'Aquila during 1996/97; of these 27 (19 adults, 8 in the growing phase) required orthodontic and implant treatment. All eight growing patients presented malocclusions and space deficiency determined by tooth agenesis (six upper lateral incisors, two lower premolars).
METHODS: In the growing patients orthodontic treatment was accomplished first, while the implant was placed at the end of pubertal growth/development. In borderline cases a slight modification of the implant position relative to the surrounding teeth was performed. For each patient orthodontic treatment was planned after an evaluation of bone space (thickness, height and mesio-distal distance) and a bone integration of the implant after set-up of the models was conducted.
RESULTS: In all the treated subjects a satisfactory resolution and perfect bone integration with the re-establishment of the functional and aesthetic conditions was obtained. Usually in growing patients the arrangement of implants may not be indicated, even if in borderline cases the alteration of the implant position may be very reduced compared with the functional and aesthetic advantages.
CONCLUSION: A multifactorial approach (orthodontic-implant) is the appropriate way to proceed either in adults or growing patients.

30 THE DYSFUNCTIONAL FACTOR IN THE INCIPIENT TEMPORARY AND MIXED DENTITION

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AIM: To investigate the incidence of oral dysfunction and its correlation with malocclusions, in the incipient temporary and mixed dentition periods.
SUBJECTS: Six hundred and eight unselected, pre-school children, whose ages ranged from 3 to 6 years, from several kindergartens in the town of Cluj-Napoca, Romania.
METHOD: A clinical examination of the children (malocclusions and dysfunctions) was performed. The data were analysed, considering the existence (with 1-year differences) of age groups, and then establishing either the incidence of malocclusion or dysfunction and the correlation between the two.
RESULTS: From all subjects, 446 presented malocclusions (65.5 per cent) and 388 dysfunctions (57 per cent), of which, 143 children presented a single dysfunction and 119 children associated ones. From the subjects with malocclusions, 316 presented dysfunctions (70.8 per cent). At 3 years of age the second most frequent single dysfunction was a sucking habit. For ages 4 and 5 years the frequency of dental factors increased (absence of abrasion of the cusps). Of the subjects with malocclusions, 40.5 per cent presented associated dysfunctions.
CONCLUSIONS: The increasing frequency of malocclusions and oral dysfunctions in pre-school children highlights the need for increased dental education and improved interaction between the family and didactic staff.

31 NEOVASCULARIZATION OF ENDOCHONDRAL BONE GRAFT WITH DEMINERALIZED INTRAMEMBRANOUS BONE MATRIX

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AIM: To determine the in-growth of new blood vessels in composite endochondral (EC) bone and demineralized bone matrix (DBM) from intramembranous (IM) origin ($EC\text{-}DBM_{IM}$).
MATERIALS: Thirty two rabbits were used as the experimental group and 32 critical-size (10×5 mm), full thickness bony defects in rabbit parietal bone were implanted with composite autogenous EC bone and DBM_{IM} ($EC\text{-}DBM_{IM}$) and EC bone alone.
METHODS: Histological changes were examined 1, 2, 3, 4, 5, 6, 7, and 14 days post-grafting. Neovascularization was assessed by immunohistochemical staining with anti-human angiogenesis related antibodies (EN 7/44). Quantitative analysis of neovascularization, represented by percentage area of positive immunohistochemical staining, was performed on 320 sections of the experimental groups using a computer-assisted image analyser.
RESULTS: Positive immunohistochemical staining was first identified on day 2 post-grafting for the composite $EC\text{-}DBM_{IM}$ bone graft group compared with day 4 in the EC bone graft group. The composite $EC\text{-}DBM_{IM}$ bone graft group showed earlier and almost 100 per cent more neovascularization when compared with the EC bone graft group.
CONCLUSION: DBM_{IM} enhances the healing and integration of EC bone graft by inducing faster vascularization as well as increasing the number of blood vessels.

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32 TOOTH DEVELOPMENT IN DLX-1, DLX-2 AND ACTIVIN-βA MUTANT MICE EMBRYOS

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AIM: To analyse the development of teeth in two transgenic mice strains with targeted disruption mutations for Activin-βA, Dlx-1, Dlx-2 and Dlx-1 and -2.
MATERIALS AND METHODS: Heads of 13 genotyped mice with knock outs of Dlx-1, Dlx-2 and Dlx-1 and -2 were processed for histological investigation. The gestational age ranged from embryonic day 13.5 to 4 days after birth.
RESULTS: In the Activin-βA group, 17 genotyped mice were investigated histologically, the gestational age ranged from embryonic day 12.5 to new-born. Mice with mutations in the Activin-βA gene showed abnormal development of incisors and mandibular molars. The phenotype ranged from complete absence to very malformed tooth germs. No abnormalities were found in the mice carrying a mutation in the Dlx-1 or Dlx-2 gene. However, in mice where Dlx-1 and -2 were both disrupted, the maxillary molars did not develop.
CONCLUSION: Previously described knock-outs of other genes have either revealed total absence or halted dental development affecting all teeth. The Dlx-1 and -2 genes are, together with Activin-βA, the first genes that have been shown to affect only specific tooth groups. These results may be relevant in the development of a hypothesis for dental patterning and therefore for hypodontia.

33 WHOSE FACE IS IT ANYWAY?—THE ASSESSMENT OF FACIAL PROFILES

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AIM: To determine whether the most attractive facial profile chosen by orthodontists, maxillo-facial surgeons, dental students and members of the general public is a Class I profile.
MATERIALS AND METHODS: Black and white photographs of two male and two female adult subjects with Class I profiles were scanned into a computer graphics programme and the image for each subject manipulated to produce a Class II, Class III and long face profile. The four images for each subject were ranked in order of attractiveness by 40 orthodontists, 32 maxillo-facial surgeons, 40 dental students and 40 members of the general public. The data were evaluated with SPSS for Windows. Logistic regression analysis determined whether the type and sex of the assessor, and the sex of the subject were significant factors when ranking the most attractive profile.
RESULTS: Significant differences were found between orthodontists and the general public when examining subjects 1 and 3 ($P < 0.01$). The sex of the assessor was also a significant factor for subject 3, where female assessors were more likely to rank the Class I profile first ($P < 0.05$). When considering all four subjects, a significant difference was found between orthodontists and both dental students ($P < 0.01$) and the general public ($P < 0.001$) when assessing the Class I profile as the most attractive. Similar results were noted for maxillo-facial surgeons.
CONCLUSIONS: Orthodontists and maxillo-facial surgeons are more likely to choose a Class I profile as more facially attractive than lay persons or dental students. These differences may be explained by the training and experience of the clinicians in planning treatment to produce a Class I profile whenever possible.

34 Ti-Nb® ORTHODONTIC ARCHWIRES

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AIM: To characterize Ti-Nb® orthodontic archwires.
MATERIAL: Commercial 0.017 × 0.025 inch (0.435 × 0.64 mm) orthodontic archwires.
METHODS AND RESULTS: The composition of the Ti-Nb® archwires was studied with a scanning electron microscope. The composition was found to be 53 per cent Ti, 46.6 per cent Nb and 0.2 per cent Si. The transformation temperatures were investigated with differential scanning calorimetry from –40ºC to +600ºC. The crystallographic structure remained unchanged in the range of buccal temperatures. Mechanical properties were studied with the aid of a torsion apparatus (French patent 8906480) to simulate conditions of clinical use. Ti-Nb® orthodontic archwires were tested and compared with stainless steel (Ormco), TMA® and NiTi. The behaviour in torsion of Ti-Nb® and of TMA® was very similar. The stiffness of these alloys was halfway between those of the stainless steel and NiTi.
CONCLUSIONS: Ti-Nb® was shown to be nickel free. Its stiffness is not affected at mouth temperature. Performances of Ti-Nb® and TMA® being closely identical, their clinical use should give identical results. Ti-Nb® seems nevertheless to deliver lighter moments than TMA®.

35 MYOFIBROBLASTS AND MATRIX COMPONENTS IN HEALING PALATAL WOUNDS IN THE RAT

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AIM: To describe the healing of standardized palatal mucoperiosteal wounds in the young rat. This model will be used to study wound healing after cleft palate surgery.
MATERIAL: Five-week-old Wistar rats.
METHODS: Standardized wounds (ø 3 mm) were made in the palatal mucoperiosteum of 26 rats. Six rats served as

unwounded controls. The animals were sacrificed at several time points between 0 and 60 days post-wounding (PW) and the distribution of collagen types I and III, elastin, and α-smooth-muscle actin was analysed (immuno)histochemically. α-smooth-muscle actin was used as a marker for myofibroblasts.
RESULTS: Myofibroblasts were found in the mucosal part of the tissue between 4 and 22 days, with the highest density at 8 days PW. Collagen types I and III were first detected at 3 and 4 days PW, respectively. The amount of both collagen types gradually increased until 8 days PW. Collagen type I was equally distributed across the wound, while type III was concentrated adjacent to the epithelium. At approximately 10 days PW, the amount of collagen type III had decreased and most of the type I fibres were aligned transversely. At 60 days PW still no elastin had been deposited in the scar tissue and less collagen type III was present than in normal submucosa.
CONCLUSION: The results indicate that in this model wound contraction takes place in the mucosal part of the mucoperiosteum between 4 and 22 days PW. The increased ratio of collagen type I to type III and the lack of elastin in the scar tissue will increase its rigidity. A similar change in the mechanical properties of scar tissue after cleft palate surgery may contribute to the disturbed maxillary growth and dento-alveolar development. This model will be used to develop pharmacological therapies to reduce wound contraction and scar formation after cleft palate surgery.

36 DEVELOPMENTAL PROCESSES IN A TRANSGENIC MOUSE MODEL OF HEMIFACIAL MICROSOMIA

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AIM: To study the facial development of the transgenic mouse model for hemifacial microsomia (HFM) during a key period in facial development.
MATERIAL: Thirty six transgenic heterozygous and 41 wild-type embryos aged E13.5–17.5.
METHODS: Mouse embryos were generated by cross-breeding transgenic heterozygotes with wild-type adults. The embryos' genotype was determined using polymerase chain reaction tests on tail section DNA. All of the transgenics and two wild-types from each developmental day were processed for wax histology and examined in the coronal plane.
RESULTS: Eight of the 36 transgenic embryos (22 per cent) were abnormal. These were all heterozygous since no homozygotes survived to stage E13. Therefore, the loss of function mutation at locus B1–3 on chromosome 10 was transmitted in an autosomal manner, but with a reduced penetrance rate. The heterozygous embryos displayed specific (mostly bilateral) anomalies including hypoplasia of the auricle, external auditory meatus, auditory ossicles and tubotympanic recess (developing pharynx). In addition, four (33 per cent) of the E14.5 and 15.5 heterozygotes displayed a novel finding: inferior displacement of the developing inner ear with transposition of the tubotympanic recess between this and the cranial base. Palatal shelf fusion also was incomplete in six embryos and the glenoid fossa was rudimentary in three of the E15.5 specimens. However, there were no detectable abnormalities in the developing inner ear or mandible.
CONCLUSION: A single gene defect is capable of causing HFM-type cranio-facial anomalies. As such, the Hfm transgenic mouse represents an alternative model for the study of HFM despite the apparent normality of the lower facial tissues and homozygous lethality.

37 DO ORTHOGNATHIC PATIENTS DIFFER PSYCHOLOGICALLY FROM A CONTROL GROUP?

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AIM: This questionnaire-based study investigated the psychological profile of orthognathic patients prior to any active treatment and compared the findings with a control group.
SUBJECTS: Eighty four patients requesting orthognathic treatment and 106 individuals recruited from local colleges and offices (control group).
METHOD: A questionnaire was devised which assessed various aspects of an individual's psychological profile. The outcome variables were: state and trait anxiety, depression, perceptions of social support, self-esteem, body image and facial body image. Respondents were matched as closely as possible for age, gender and ethnic group but were not one for one matched. For this reason, data were analysed using the MLwiN programme for multivariate multiple regression analysis where the outcome variables and independent variables were studied simultaneously. This allowed the impact of dento-facial deformity to be established whilst still taking into account variations in the demographic variables between the two groups.
RESULTS: This study showed variations in the psychological profile of the orthognathic group with respect to the control group. The orthognathic patient showed higher levels of state anxiety ($P < 0.001$), higher numbers of individuals in their social support network ($P < 0.001$) and lower body and facial body image ($P < 0.001$ for both). Self esteem was also found to be lower in the orthognathic group but only at borderline levels ($P = 0.05$).
CONCLUSIONS: This method of data analysis is useful in the comparison of two groups where it is difficult or impractical to match one for one. Significant variations between the two groups were detected even when demographic variations were accounted for.

38 INFLUENCE OF PREMOLAR EXTRACTIONS ON THE POSITION OF THE LOWER THIRD MOLARS

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AIM: To evaluate the lower third molar position after premolar extractions.
MATERIAL: Pre- and post-treatment panoramic radiographs of 14 girls, with an age range of 11–15 years, treated by extraction of premolars. The mean treatment time was 2 years.
METHOD: Changes in the inclination of the lower third molars, and also of the second premolars and first and second molars, were measured in relation to the occlusal and mandibular planes, respectively. In addition, changes in the angle formed between the long axis of the third and second molars were measured. All measurements were undertaken bilaterally. Paired *t*-tests were performed to statistically evaluate the results.
RESULTS: Statistically significant changes were found only in the inclination of the left first molar and right second molar in relation to the mandibular plane ($P < 0.01$ and 0.001, respectively).
CONCLUSION: The results obtained lead to a conclusion that the inclination of the lower third molar does not appear to be influenced by premolar extraction.

39 CARIOSTATIC EFFECT OF A RESIN-REINFORCED GLASS-IONOMER FOR BONDING BRACKETS *IN VIVO*

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AIM: To evaluate *in vivo* the cariostatic potential of the resin-reinforced glass-ionomer (Vitremer®) used for bonding orthodontic brackets.
MATERIAL: Nine pairs of premolars extracted for orthodontic reasons.
METHODS: A split-mouth technique using orthodontic brackets bonded on one tooth of each pair with the resin-reinforced glass-ionomer and the control contralateral premolar with the non-fluoridated composite. After 4 weeks all teeth were extracted and mineral distribution and topography of the enamel surface adjacent to the bracket base was determined by quantitative microradiography (TMR) and confocal laser scanning microscopy (CLSM).
RESULTS: The lesion depths and mineral loss values in enamel adjacent to brackets bonded with Vitremer® were significantly lower than in teeth bonded with the composite. CLSM images showed a severe cariogenic challenge around orthodontic brackets and support TMR measurements.
CONCLUSIONS: Resin-reinforced glass-ionomers significantly inhibit caries lesion development *in vivo* as compared with a non-fluoridated composite. By combining conventional TMR with the new technique of CLSM unique information on the ultrastructural details of hard tissues exposed to caries can be obtained.

40 THE EFFECTS OF IGF-1 ON GROWTH OF THE RAT CARTILAGE

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AIM: To compare *in vitro* the growth of the mandibular condyle of new-born rats with the growth of the femoral head and to analyse the effects of IGF-1 on these two types of cartilage.
MATERIAL: Ninety four mandibular condyles and 92 femoral heads from 4-day-old Wistar rats.
METHODS: The femoral heads and the mandibular condyles were dissected and cultured for 2 weeks with 0, 5 and 25 ng IGF-1/ml. Standardized photographs were taken three times per week to monitor growth. At regular intervals, samples were harvested to analyse the glycosaminoglycan (GAG) and hydroxyproline contents of the cultures.
RESULTS: After 2 weeks, the mean area of the mandibular condyles increased from 3.02 mm^2 to 5.22 mm^2 without IGF-1 and from 2.92 mm^2 to 6.35 mm^2 with 25 ng IGF-1. The mean area of the femoral heads increased from 2.52 to 5 mm^2 without IGF-1 and from 2.64 to 5.93 mm^2 with 25 ng IGF-1. During linear growth in the last week, with 25 ng IGF-1, the growth rate of the mandibular condyles was 0.214 mm^2/day and the rate of the femoral heads was 0.172 mm^2/day. The GAG content of the femoral heads was four times greater than that of the mandibular condyles and the hydroxyproline content was similar; they were not modified by IGF-1.
CONCLUSION: 25 ng IGF-1/ml medium increased the growth of mandibular condyles and femoral heads in culture. With 25 ng IGF-1, the growth rate during the last week was higher for the mandibular condyles than for the femoral heads. This culture model is suitable to compare the effects of growth factors on cartilage of new-born rats.

41 CERVICAL SPINE FINDINGS IN CLEFT LIP AND PALATE PATIENTS

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AIM: Cleft lips and palates are often just one symptom of more complex disturbances in optogenetic development, either caused by genetic or other exogenous influences. Therefore other skeletal alterations are to be expected. This study was intended to scrutinize the cervical spine configuration in lateral cephalograms of cleft patients.
MATERIALS AND METHOD: Lateral cephalograms of 183 cleft lip and palate patients (109 male, 74 female) between 4 and 31 years were compared with those of 197 patients without a cleft. Biometric evaluations of the cervical

vertebrae, inter-vertebral spaces and spinal canal widths as well as the atlanto-axial and atlanto-occipital relationships were performed. Pathologies leading to structural loosening or restriction of movement were ascertained. Statistical analyses were performed ($\propto = 0.05$).
RESULTS: The anatomical configurations of the cervical vertebrae were found not to differ significantly regarding biometric aspects from the comparison group. However, in 14.21 per cent more defects and dyplasias of the vertebral arches and bodies were found compared with 2.54 per cent in the control group. On the other hand, an increased number of fusions and assimilations, 9.84 per cent, could also be seen (control group: 3.05 per cent). Degenerative changes were also found more often in patients with clefts.
CONCLUSION: The skeletal findings imply that the pathology underlying cleft oral structures might be more complex than previously supposed. From a clinical point of view, the percentage of structural loosening and blockage in these patients should prompt anaesthetists to be more careful during operations, as there might be a greater risk of injury to their spinal cord.

42 THE EFFICIENCY OF DIFFERENT TOOTHBRUSHES IN PATIENTS WITH FIXED ORTHODONTIC APPLIANCES

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AIM: Fixed orthodontic appliances place high demands on the oral hygiene of patients. As toothbrushes are the fundamental cleaning instruments for removal of plaque and reduction of intraoral gingivitis, a wide range of brush types are commercially available. The aim of this study was to evaluate the efficiency of an electric toothbrush of the latest generation in comparison with a conventional manual toothbrush.
SUBJECTS AND METHOD: Thirty five patients with fixed orthodontic appliances were asked not to perform their normal oral hygiene for two days before their appointment. They had been instructed how to use the electric toothbrush (Plaque Control 3D, Braun-OralB Co.) at the previous control visit. The device combines an oscillatory movement with a vibrational swing of 0.1 mm along the bristle axes. This is said to produce an increased cleaning effect, particularly in the approximal spaces. A further 35 patients, who had also been instructed how to manually use their toothbrush and abstained from cleaning for 2 days prior to assessment, served as a control group. Both groups were asked to clean their teeth according to the instructions for 3 minutes. A modified Quigley-Hein test was then performed as well as a gingival-bleeding index. A questionnaire was designed to give information on the patients' attitudes towards the handling of the toothbrushes.
RESULTS: There was a tendency to achieve better cleaning effects with the electric toothbrush in the lateral region of the mandibular and maxillary arches, especially in the areas difficult to reach. However, there were great individual differences in effective brush application. In general, the use of the electric toothbrush was considered to be more comfortable and easier, because the cleaning swing was taken over by the brush. The patient must only press the device onto the teeth to be cleaned.
CONCLUSION: Although electric toothbrushes are only slightly more effective than manual ones, they can induce improved compliance because of their facilitated handling. This applies in particular to younger children. Therefore, whenever there might be problems in management of proper cleaning, an electric toothbrush might be indicated to maintain an adequate standard of oral hygiene throughout orthodontic treatment.

43 INFLUENCE OF THE INTRAORAL CAMERA ON THE DENTAL HYGIENE OF ORTHODONTIC PATIENTS

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AIM: Orthodontic treatment, with its relatively long therapy time, can be very challenging in order to maintain an adequate standard of oral hygiene in a young patient's mouth. With the intraoral camera a new technique has become available, which can be applied in education as well as in information for the patient and parents. This study was intended to evaluate the use of an intraoral camera for hygiene instruction and motivation.
SUBJECTS AND METHOD: Two groups of 30 patients each, one treated with fixed and the other with removable appliances, were instructed in oral hygiene by means of an intraoral camera (Dentview®, Halinenkratt Co., Germany). Photographs were taken of the main problem zones for cleaning and a print of them was handed to the patients. Two control groups of 30 patients with fixed and removable appliances each were taught oral hygiene without the visual stimulation of intraoral images. On the day of instruction, as well as at the next control appointment, the dental hygiene was measured applying the approximal plaque index of Lange and a sulcus bleeding index. Using a questionnaire the patients' attitudes towards oral hygiene and the camera device were investigated.
RESULTS: There was a tendency that patients instructed with an intraoral camera cleaned their teeth better and showed more interest in oral hygiene. The cleaning results, nevertheless, showed great individual differences. However, the value of the device lies mainly in an improved communication and better understanding, when clinical problems have to be discussed and viable solutions suggested.
CONCLUSION: The intraoral camera has certain positive effects when being used to improve hygiene during orthodontic therapy. Its main strength can be summed up as an additional tool to increase the flow of information between patient and orthodontist.

44 MONITORING TEMPOROMANDIBULAR JOINT FUNCTION IN CLASS II DIVISION 1 GROWING PATIENTS UNDERGOING BIONATOR THERAPY

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AIM: Early temporomandibular (TMJ) dysfunction symptoms are frequent in young patients with Angle's Class II division 1 malocclusions with mandibular retrognathism. One of the treatment modalities considered adequate for this type of malocclusion includes the use of an orthopaedic-functional appliance to enhance mandibular growth and regularize function. The aim of this study was to determine whether or not this treatment modality truly improved patient function.
SUBJECTS: The changes occurring in TMJ function of 30 growing patients with Class II division 1 malocclusions were monitored throughout 18 months of treatment performed with a functional orthopaedic appliance (Balters bionator) and subsequently with a fixed orthodontic appliance.
METHODS: Two different methods were used to evaluate the results: 1) A clinical evaluation categorizing the patients according to the clinical Dysfunction Index of Helkimo (DI) and 2) axiography according to Slavicek.
RESULTS: A diminished extension of the protrusion from 12.3 to 11.6 mm ($P < 0.05$) was recorded axiographically while maximum opening remained stable. Moreover, a slight flattening of the protrusive and maximum opening paths was observed. The most relevant change was that 70 per cent of the symptomatic patients exhibited linearity in the axiographic paths. The variations of the relative percentage among the different groups of DI from the beginning to the end of treatment were from 6.7 to 46.7 per cent ($P < 0.01$) for the asymptomatic patients; from 63.3 to 53.3 per cent ($P < 0.01$) for the mild DI and from 30 to 0 per cent ($P < 0.01$) for the moderate DI. No patient was classified with severe DI. All the differences, analysed with a Student's *t*-test, were statistically significant.
CONCLUSION: These results show a significant clinical and axiographic improvement of articular function, but this was not sufficient to normalize completely all different degrees of dysfunction in all the patient groups during treatment.

45 HEMISECTION OF SECOND DECIDUOUS MANDIBULAR MOLARS IN THE ABSENCE OF SECOND MANDIBULAR PREMOLARS

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In a study of school children Bachmann found a percentage of missing teeth of 4.21 for boys and 4.53 for girls. Thus it can be concluded that in the orthodontic practice almost 1 in 10 patients will have oligodontia of the second mandibular premolars. Hemisection of the second deciduous mandibular molars has been described in the literature. However the technique is relatively new. It is a simple procedure to permit easier movement of the first mandibular molar into the space of the extracted deciduous molar, because alveolar bone is preserved by this technique. In most subjects oligodontia of the second mandibular premolars is bilateral. However in some subjects the second premolar is absent on only one side.
SUBJECTS AND METHOD: Hemisection was used in clinical patients to facilitate bodily movement of the mandibular first molar into the extraction space of the second deciduous mandibular molar. The different treatment options in all types of occlusion will be presented. The hemisection technique has been used in more than 40 patients and can extend differential diagnosis.

46 INFLUENCE OF CHEMICAL STRUCTURE ON THE SETTING BEHAVIOUR OF GLASS-IONOMER CEMENTS

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AIM: To achieve the bonding properties of glass-ionomer cements (GICs) in the context of bracket cementing in orthodontics, the following study examined the influence of chemical structure on the setting behaviour of GICs.
MATERIALS AND METHOD: To analyse the setting process in greater detail, the heat flux was determined over 24 hours at a measuring sensitivity of 3000 μW and over 115 hours at 30 μW in an isothermal microcalorimeter (Thermometric, Sweden). An isopiestic analysis of all 12 samples was carried out in climatic chambers at 0, 84 and 100 per cent atmospheric humidity. Two groups of GICs and one composite were studied.
RESULTS: In the microcalorimetric analysis to establish the setting rate, the conventional GICs showed the slowest heat reduction and the greatest heat development, followed by the light-curing GICs. The composite was virtually inert. The isopiestic experiments to determine the proportion of combined water showed an increased water uptake for the light-curing GICs containing maleic acid. This plasticizing function reduces the bond strength.
DISCUSSION: For increased bonding strengths, GICs for bracket cementing should be based more on polyacrylic acid and less on polymaleic acid. This minimizes the proportion of combined water and markedly improves bonding strengths. A light-curing GIC is recommended because its higher reactivity leads to more rapid setting, thereby reducing the susceptibility to problems in the setting phase.

47 CLINICAL COMPARISON OF LIGHT- AND SELF-CURED REMOVABLE APPLIANCES

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AIMS: To investigate the claims that light-cured acrylic resin appliances reduce the prevalence of palatal inflammation

and that they are sufficiently durable for routine orthodontic use.
SUBJECTS: Sixteen patients issued with visible light-cured (Triad, DeTrey) appliances (mean age 13.3 years) and 19 with self-cured (Orthoresin) appliances (mean age 13.5 years).
METHOD: Palatal redness was measured at appliance issue and after 1 and 3 months with the Erythema meter (Cross *et al*., 1998) along with plaque scores (Sillness and Löe, 1964). A record of appliance breakages was also kept.
RESULTS: No significant difference was found in palatal redness between the two materials, suggesting that claims regarding the hardness of the light-cured material reducing absorption of saliva and bacteria were clinically insignificant. Six patients in the light-cured group broke their appliances during the 3-month period compared with none in the self-cured group. This appeared to be partly related to the thickness of the light-cured material in the first batch of appliances. Thickness was subsequently increased and breakages reduced.
CONCLUSIONS: Light-cured baseplate material is no better than self-cured in controlling palatal redness. Further research is still required concerning its clinical durability during routine orthodontic use despite its less hazardous handling properties.

48 HYPODONTIA AND DENTAL FORMATION IN CLEFT AND NON-CLEFT SIBLINGS

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AIM: To compare the occurrence of dental anomalies (hypodontia, tooth formation and dental asymmetry) in cleft-affected children with their siblings and with a non-sibling control group in order to estimate the genetic contribution of the occurrence of a cleft to associated dental anomalies.
MATERIAL: Panoramic radiographs were collected of 54 cleft-affected children (aged 4.2–13.1 years), 63 non-cleft siblings (aged 4–14.9 years) and 250 non-sibling control children (aged 4–14.9 years).
METHODS: Hypodontia, dental age (estimated by the method of Demirjian) and dental asymmetry were assessed on the panoramic radiographs of all the children. Descriptive statistics were performed in order to test the distribution of the data and then unpaired *t*-tests. F- and Chi-square tests were undertaken.
RESULTS: Both the cleft and the sibling group showed a significantly greater frequency of hypodontia ($P < 0.05$) and a significantly higher risk to develop dental asymmetry ($P < 0.01$), than the control group. Concerning dental formation, no significant dental decay could be found in the cleft children and their siblings, compared with the controls.
CONCLUSIONS: It can be concluded from these results that genetic factors, contributing to the formation of the cleft, must be closely related to the genes responsible for dental anomalies.

49 MEASUREMENT TRANSFER BETWEEN TWO- AND THREE-DIMENSIONAL ORTHOGNATHIC SURGERY PLANNING WITH THE KD-MMS®

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AIM: The calibrated Münster Model Surgery System (KD-MMS®) was developed with mountable instruments on the articulator pin, to integrate limited individual three-dimensional (3D) elements for orthognathic surgery planning.
MATERIAL AND METHODS: With surgical VTO [two-dimensional (2D) lateral cephalograms] and the model surgery in articulators (3D) measurements can be transferred with the KD-MMS® using the axis-orbital plane as a reference. The eight further surgery lines, which are constructed as parallels or perpendiculars to the axis-orbital plane, make 2D or 3D controlled movements in different osteotomy regions possible.
RESULTS: The transfer of the maxillary osteotomy plane from the lateral cephalograms into the 3D KD-MMS® model surgery individualizes and significantly improves measurement precision. The individual articulator pin-distance transfer from the 3D into the 2D planning reduces the error rate for the individual incisor position.
CONCLUSION: An improved interdisciplinary measurement transfer has been achieved for orthognathic surgery in the last 5 years (505 mono- and bimaxillary orthognathic procedures have been undertaken) with the KD-MMS®.

50 VERSATILITY OF TOOTH-BORNE DEVICES FOR MANDIBULAR OSTEODISTRACTION

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AIM: To evaluate a tooth-borne device for mandibular osteodistraction in different applications.
SUBJECTS: Nine Caucasian adult patients (six with mandibular retrognathia, two with mandibular dento-alveolar retrusion, and one with open bite and mandibular retrognathia).
METHODS: Tooth-borne mandibular osteodistraction devices were fabricated for each patient and were aligned horizontally parallel to the vector of distraction, but individualized vertically according to the degree of overbite. Pre- and post-treatment records (lateral cephalometric radiographs and dental study models) were taken and analysed.
RESULTS: Statistical analysis (*t*-test) showed a significant increase in arch length and advancement of the osteotomized anterior portion of the mandible in all cases. There was also bending of the anterior segment especially in totally osteomotized mandibles.
CONCLUSION: Tooth-borne mandibular distraction devices have many advantages over extra- and intra-oral bone-borne

distraction devices. Significant advancement and bending of the anterior parts of the osteomotized mandibles occurs. More studies are needed to evaluate the effects of using such devices on teeth, periodontium and temporomandibular joints.

51 VOICE VARIATION RELATED TO RAPID MAXILLARY EXPANSION

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AIM: To analyse the voice parameters of patients after rapid maxillary expansion (RME) using orthopaedic appliances or surgically assisted RME.
SUBJECTS AND METHODS: Fifteen patients, ranging between 14 and 25 years of age, were analysed for voice parameters using the computerized speech laboratory. For all patients, RME was performed using a Hyrax appliance. Two groups were formed: an orthopaedic group (nine patients) and a surgically-assisted group (six patients). The extracted voice parameters were as follows: the amplitude perturbation quotient which measures the period-to-period variability of the peak-to-peak amplitude within the analysed voice sample at smoothing of 11 periods, average fundamental frequency (F_0) which is the average value of all extracted period-to-period fundamental frequency values, noise to harmonic ratio (NHR) which is a general evaluation of noise present in the analysed signal, Jitter per cent (Jitt) and Jitter absolute (JitA, usec) which are the evaluation of the period-to-period variability of the pitch period within the analysed voice sample, and Shimmer in dB and Shimmer per cent which are relative evaluations of the period-to-period (very short term) of the peak-to-peak amplitude within the analysed voice sample.
RESULTS: F_0 and NHR decreased in both groups. The JitA increased in both groups. As regards the other parameters, an increase was observed in the orthopaedic group whereas the surgery group showed a decrease.
CONCLUSION: The different dental, muscular and skeletal responses in the two expansion procedures might have accounted for the change in voice parameters between the two groups.

52 CEPHALOMETRIC MEASUREMENTS FOR THE POSITION OF THE LOWER INCISORS

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AIM: Since the amount of mandibular tooth movement in the sagittal and transversal directions is limited with respect to the maxilla, the position of the lower incisors on the apical base of the mandible has more effect on the decision to extract in subjects with crowding. The aim of this study was to analyse the effectiveness of different cephalometric measurements for the assessment of the position of the lower incisors on the apical base of the mandible.
MATERIALS: Lateral cephalometric radiographs of 96 untreated adults (55 females with a mean age of 21.63 years, and 41 males with a mean age of 22.45 years) with ideal Class I occlusal relationship, well-aligned upper and lower dental arches, and a complete dentition.
METHODS: Lateral cephalometric radiographs were traced and measured by a single investigator. L1-NB (mm), L1-APg (mm), L1-NPg (mm), Pg-NB (mm), Holdaway difference (mm), L1-B (mm), Pg-B (mm), L1-Pg (mm), L1/NB (°) and L1/Mandibular Plane (°) were chosen as linear and angular parameters to evaluate the position of the lower incisors sagittally and SN/Mandibular Plane (°), SNA (°), SNB (°), S-N (mm), S-A (mm) and S-B (mm) to evaluate the skeletal relationship vertically and sagittally. Statistical analysis of the data included descriptive statistics, Wilcoxon test for paired groups, Mann Whitney *U*-test for independent groups and correlation analysis for the associations between the variables.
RESULTS: Wilcoxon test for both sexes showed similar results with statistically significant differences between the linear measurements for the position of the lower incisors. Significant correlation coefficients between SN/Mandibular Plane and L1-NB, L1-APg, L1-NPg, Pg-NB, Holdaway difference, L1/NB were found in both sexes.
CONCLUSION: The results suggest that some of the measurements for the position of the lower incisors correlate with the vertical skeletal relationship. It seems reasonable to assume that the lower incisors may appear to be more protrusive due to an increased vertical skeletal relationship. Therefore, it seems advisable to use measurements that may not be affected by the vertical skeletal relationship for the assessment of the position of the lower incisors on the apical base of the mandible.

53 EVALUATION OF SKELETAL ASYMMETRY IN AESTHETICALLY PLEASING FACES WITH NORMAL OCCLUSION

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AIM: To determine skeletal asymmetry in aesthetically pleasing faces with an Angle Class I occlusion.
SUBJECTS: Twenty females with normal vertical growth (GoGnSN: 25–39 degrees), Angle Class I occlusion and skeletal Class I relationship (ANB 0–4 degrees). The non-growing subjects' mean age was 14 years 4 months.
METHOD: Postero-anterior cephalograms were obtained and reference points and lines were determined. A vertical line (Vr) was drawn from crista galli to the line connecting laterosuperior orbit points (Lo), and horizontal distances to this line from points Lo, nasal cavity (Nc), Zygoma (Zg), Maxilla (Mx), Gonion (Go), Mastoid (Ma) were measured for right and left sides respectively. In addition the vertical distance between points Zg and Go were measured parallel to the Vr for right and left sides. Paired *t*-tests were performed to compare the measurements between right and left sides.

RESULTS: Statistically significant differences were found between right and left sides for the horizontal measurements from the points Lo, Zg, Mx and Go to the Vr ($P < 0.01$). The horizontal distance of Nc to the Vr showed a statistically significant difference between right and left sides ($P < 0.05$). The vertical distance between points Zg and Go also showed statistically significant differences between right and left sides ($P < 0.05$). The horizontal distance of point Ma to the Vr was similar for right and left sides.
CONCLUSION: By using postero-anterior analysis statistically significant skeletal asymmetries between right and left sides were found in clinically symmetrical faces.

54 THE FORCE MODULE OF THE ORTHOMATE™ AND ITS CLINICAL RELEVANCE FOR TREATMENT PLANNING

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AIMS: After testing the accuracy and plausibility of the force module of the Orthomate™, the object of this investigation was to demonstrate the clinical relevance of this software component.
MATERIALS AND METHOD: The study was based on data from 10 patients treated with the Orthomate™. The treatment planning in these subjects was performed in accordance with the basic principles of assessing the clinical situation, with special regard to the appropriate choice of the variable parameters such as wire cross-section, diameter, material and the determination of a wire sequence with acceptable graduations. The corresponding force module readings for these wires were evaluated, and the clinical result, under special consideration of radiographically visible changes in root configuration, explained. In a further step, treatment planning was repeated after imposing upper limits on the computed forces. Not only the corresponding wire cross-section, diameter and wire material, but also the wire sequence that would be theoretically efficient in these circumstances will be presented.
RESULTS: The computed pressure values which were considered to be effective in the periodontium after inserting the corresponding wires were calculated and found to be between 0.38 N/cm^2 in the area of the upper molars, and 2.36 N/cm^2 in the area of the lower incisors. Simulation of treatment modified by reducing the maximum forces to 1 N/cm^2 leads to clinically unusual changes in treatment planning in terms of the variable parameters.
CONCLUSIONS: The force module is a first step in providing a rapidly available and reproducible estimation of the forces acting on the teeth and periodontium, and enables a comparative evaluation of various treatment concepts with reference to the respective forces. In particular, the results of the simulation should be judged critically until the force module yields objective data on the real forces in the periodontium.

55 LOWER LIP LENGTH AND INCISOR INCLINATION IN SKELETAL CLASS II SUBJECTS

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AIM: To investigate the correlation between lower lip length and upper and lower incisor inclination in skeletal Class II division 1 and 2 subjects.
MATERIAL: Lateral cephalograms of 75 patients older than 16 years of age with skeletal Class II division 1 and 2 malocclusions before treatment.
METHODS: The upper and lower incisor inclination (1 to SN, 1 to GoGn), lower lip length (Sto-Gn), ANB angle and overbite were measured on the radiographs. ANB angle above 4 degrees was considered skeletal Class II. The correlation between them, their direction and significance were studied by Rank Correlation Test.
RESULTS: In the Class II division 1 group (40 patients) the correlation between lower lip length and lower incisor inclination was significant ($P < 0.04$). In the division 2 group (35 patients) the correlation between lower lip length and upper incisor inclination was not significant ($P < 0.06$). In both groups the correlation between lower lip length and overbite was significant ($P < 0.001$, $P < 0.02$ respectively).
CONCLUSIONS: The significance of correlation between lower lip length and lower incisor inclination in Class II division 1 subjects may explain lip activity when overjet is increased and the lower lip compensates for oral seal. The significant correlation between upper incisors and lower lip length in Class II division 2 subjects probably relates to lingual inclination of these teeth.

56 IS ROOT FORMATION OF THE LOWER CANINES AND SECOND MOLARS AN INDICATOR FOR ORTHOPAEDIC TREATMENT TIMING?

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AIM: To evaluate cephalometrically the correlation between root formation of the lower canines and second molars and the pubertal growth peak. The establishment of this intra-individual biological maturation age is of importance in the choice of the preferred treatment timing in facial orthopaedics.
SUBJECTS AND METHODS: Thirty young Brazilians between 9 years 8 months and 14 years 7 months of age (17 males and 13 females) who were undergoing orthodontic treatment. Cephalometric films in 'normal lateralis' and body height measurements were made at six-monthly intervals for a period of 2 years. The radicular formation stages were evaluated using cephalometric films of the lower canines and second molars according to Nolla's tables. These teeth showed the best radiographic images. The data were processed and statistically evaluated.

RESULTS: Female patients achieved the puberal growth peak at 10 years 6 months and males at 13 years 5 months. Concerning the relationship between Petrovic's individual growth curve and the root formation stages, the tables showed a positive correlation. In females the start of the active growth curve corresponds to stage 7 of Nolla, an average 18 months before the peak which occurs at stage 8. In males stage 8 indicates the beginning of pubertal growth, on average 2 years before the peak, which was established at stage 9 of Nolla. Stage 10 of second molars indicate post-pubertal growth curve in both sexes.
CONCLUSIONS: It can be concluded that the root formation stages of the lower canines and second molars are a realistic method in the evaluation of the individual pubertal growth peak in females and males. The results are of high value in establishing the best individual timing in facial orthopaedic treatment.

57 THE EFFECTS OF PROLONGED GUM CHEWING ON PAIN AND FATIGUE IN THE HUMAN JAW MUSCLES

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AIM: The therapeutic use of chewing-gum has been suggested in the orthodontic literature, but the potential harmful effects on the jaw musculature arising from prolonged chewing activity are poorly documented. The aim of this study was to investigate the effects of prolonged chewing activity with different bolus hardness on pain, fatigue and pressure tenderness of the masticatory muscles.
SUBJECTS AND METHOD: Fifteen healthy women were requested to perform one of the following chewing tasks, in three separate sessions: chewing very hard gum (Mastix, Greece), chewing soft gum (Brooklyn, Perfetti S.p.A., Italy), and empty chewing with no bolus. Unilateral chewing of gum or empty chewing was performed for 40 minutes at a constant rate of 80 cycles/minute. In each session, pressure pain thresholds (PPTs) of masseter and anterior temporalis muscles were assessed before and immediately after the chewing tasks, and again after 24 hours. Perceived muscle pain and masticatory fatigue were rated on visual analogue scales (VAS) before, throughout the chewing task (at 10 minute intervals), immediately after, after 10 and 20 minutes of recovery, and again after 24 hours. Data were analysed by repeated measures analysis of variance (ANOVA) and Friedman's test.
RESULTS: The VAS scores for pain and fatigue were significantly increased (Friedman's test; $P < 0.001$) only during the hard gum chewing. Nevertheless, after 20 minutes of recovery VAS scores decreased almost to their baseline values. No significant changes were found for PPTs after both hard and soft chewing of gum (ANOVA: $P > 0.05$).
CONCLUSION: These results give support to the therapeutic use of tough gum in orthodontics and suggest that the jaw muscles recover quickly from prolonged hard and soft chewing in healthy subjects.

58 CEPHALOMETRIC CHANGES AFTER TREATMENT WITH FACEMASK AND PALATAL EXPANSION

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AIM: A prospective controlled clinical trial was designed to evaluate the skeletal and dental effects of a customized facemask with palatal expansion in the treatment of Class III malocclusions in children.
SUBJECTS AND METHOD: Twenty skeletal Class III patients with maxillary deficiency between 6 and 10 years of age were randomly divided into two equally matched groups. For each patient in the treatment group following 1.5 mm palatal expansion with a Haas appliance, a facemask (modified Delaire type) was fabricated. Applied force during the first month was approximately 200–250 g per side and doubled for 5 months. The changes in 17 cephalometric variables in the treatment group were compared with the control group after 6 months. A Mann Whitney *U*-test used for statistical analysis.
RESULTS: There was a significant improvement in maxillary size ($P < 0.001$) and position ($P < 0.001$) and significant reduction of mandibular prominence ($P < 0.001$) in the treated group. In contrast with other studies, facial vertical dimension and lower incisal angle did not show significant changes ($P < 0.05$).
CONCLUSION: Cephalometric analysis of the control group showed abnormal growth and poor prognosis for developmental progress of the facial skeleton in these patients that indicate the necessity of treatment. Rapid improvement in profile with this method motivates patients for better co-operation.

59 IMPACTED CANINES: A RISK TO BE INTERCEPTED?

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AIM: The presence of impacted canines has, according to different authors, been observed in 0.95–2.2 per cent of the population and both genetic and environmental causes have been suggested. In some cases, impacted or ectopically erupting canines can cause resorption of adjacent teeth, mainly the lateral incisors. The purpose of the study was to evaluate the prevalence of impacted canines and consequent damage and to assess the need for intercepting the risk of any possible ectopic eruption through a systematic screening of canine impaction.
MATERIALS AND METHOD: The radiological records of 5,739 patients from the Department of Orthodontics, University of Padova, were examined.
RESULTS: One hundred and sixty eight impacted canines were observed in 137 patients (2.3 per cent). Most inclusions were found in the upper arch (156), while only 32 lower canines were involved. In 12 of the 137 patients (8.7 per cent)

root resorption was observed, damaging 16 teeth (six central and 10 lateral incisors).
CONCLUSIONS: The prevalence of impacted canines observed in the examined population appears to be similar to the data available in the literature. Quite high however seems to be the prevalence of tooth resorption caused by impaction and the following ectopic eruption of the canines. It would appear that careful evaluation of the position of the unerupted canines should be performed at an early age and that subjects presenting anomalies in the path of eruption should be carefully followed radiographically to prevent or intercept possible future damage.

60 BREATHING TESTS IN CHILDREN WITH AND WITHOUT MOUTH-BREATHING SIGNS

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AIM: To compare clinical and rhinomanometric parameters in two groups of children with and without mouth-breathing signs.
SUBJECTS AND METHODS: The case group consisted of 30 subjects, 16 females and 14 males (mean age 9.4 ± 1.8 years), showing at least four of the following signs: anamnestic history, pale face, underdeveloped middle-face, small and poorly developed nostrils, abnormal lip colour, texture and posture. The control group consisted of 20 subjects, 12 females and 8 males (mean age 8.7 ± 1 years). Clinical breathing tests and anterior active rhinomanometry were performed by three clinicians, none of whom participated in the selection of groups. Diagnostic consistency evaluated by Kappa-test was good. In order to evaluate significant differences between the groups a Chi square test was performed.
RESULTS: No significant differences were found with respect to any breathing test. Quinn test: an increased respiratory frequency was observed in 23.3 per cent of subjects (versus 20 per cent for control group) holding lips closed and in 26.6 per cent of case group (versus 15 per cent control group) blocking one nostril to test the opposite side; 6.6 per cent of case group showed unilateral nasal obstruction. Rosenthal test: an increased respiratory frequency was found in 43.3 per cent of case group (versus 20 per cent control group). Gudin test: 50 per cent of case group (versus 25 per cent control group) showed a poor reflex control of the alar muscles. Anterior active rhinomanometry did not show an increase of total nasal resistance in both groups; 26.6 per cent of case group (versus 15 per cent control group) showed an increase of unilateral nasal resistance.
CONCLUSIONS: Anamnestic data and facial features often support mouth breathing diagnosis but clinical-functional tests and/or rhinomanometry can result negative for nasal obstruction. Mouth-breathing may be due to acquired habits following previous rhino-pharyngeal obstruction; this suggests that an abnormal pattern of respiration can persist even after elimination of factors causing nasal obstruction.

61 CRANIOMANDIBULAR DISORDERS: TREATMENT PLANNING USING THE ELECTROMYOGRAPH AND THE KINESIOGRAPH

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AIM: To show how of the electromyograph and the kinesiograph help to diagnose and treat masticatory muscle pain and temporomandibular joint disorders (TMD).
SUBJECTS: Twenty nine patients with craniomandibular disorders symptomatic at the time of the examination were compared with a group of previously studied healthy subjects.
METHODS: TMD is a collective term embracing a number of clinical problems that involve the masticatory musculature and the temporomandibular joints. There are many known contributing factors to the complex multifactorial nature of TMD: traumatic, anatomic, pathophysiologic, neuropathic, psychogenic and psychosocial. Therefore dysfunctional patients require an interdisciplinary collaboration between orthodontics, prosthodontics, periodontics, oral and maxillofacial surgery, implantology. All TMD patients and controls were evaluated using electromyography and kinesiography. The bioelectric processor, or EM2 electromyograph, is a diagnostic instrument used to measure muscle activity at rest and during function. The K6 kinesiograph is used to measure and record movements of the jaw in all three dimensions.
RESULTS: TMD patients have distinctly different patterns of muscle activity than asymptomatic subjects. In addition to restrictions and deviations, limitations in jaw movement are important diagnostic criteria. Successful treatment reduces the irregularity and severity of muscle dysfunction and improves mandibular movements. Comparison of pre- and post-treatment results demonstrate treatment efficacy and effectiveness.
CONCLUSIONS: The complex aetiology of TMD requires an interdisciplinary approach for successful diagnosis, treatment and maintenance. Electromyography and kinesiography are extremely valuable for initial patient evaluations, as well as for monitoring treatment results.

62 COMPARISON OF TWO TYPES OF HUMAN OSTEOBLASTS UNDER CYCLIC STRAIN *IN VITRO*

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AIM: To examine the effects of mechanical stress in human osteoblasts and a human osteosarcoma cell line under organ culture conditions with respect to interleukin production.
METHOD: Human osteoblasts were obtained from bone of cortical plate during third molar extraction and an osteosarcoma cell line (Saos-2 cells) from the American typed cell collection (ATCC). After digestion of the former, cells were seeded at a density of 2.5×10^4 cells/cm^2 in tissue culture

flasks and grown at 37ºC in a humidified atmosphere, 95 per cent air, 5 per cent CO_2 in 1:1 Ham's F12-Dulbecco's modified Eagle's medium (DMEM) supplemented with 10 per cent foetal calf serum and antibiotics. After reaching confluence during the second passage, the cells of both groups were removed with trypsin-EDTA and placed in groups of 10 cultures randomly allocated on petriperm dishes under cyclic strain of 5 seconds every 1.5 minutes during 8, 24, 48 and 76 hours. Media were collected in a longitudinal manner for determination of Interleukin-1β (IL-1β) by enzyme-linked immunoassay.
RESULTS: During mechanical stress of both types of cells there was no production of IL-1β at 8 hours. However after 24 hours the group of osteosarcoma cells could be detected in media (13.7 ± 1.2 pg/ml) and were significantly different at 48 hours (21.2 ± 1.9 pg/ml) compared with media of human osteoblasts (3.2 ± 0.8 pg/ml; $P < 0.05$).
CONCLUSION: The findings of the present evaluation can be interpreted to show that human osteosarcoma cell line release large amounts of IL-1β in comparison with normal human osteoblasts under cyclic strain.

63 EVALUATION OF BONE DENSITY USING PANORAMIC RADIOGRAPHS

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AIM: Investigation of bone density in different areas of the mandible using panoramic radiographs (OPG) as a preparatory step in the field of implantology and orthodontics.
MATERIAL: OPG and computed tomographic (CT) images of young male patients were evaluated. These normalized values were compared with the CT Hounsfield values.
METHODS: The patients were radiographed in a Siemens device. Photometrically measured OPG film densities were normalized to X-ray dose (mAs product). The dose distribution in air was determined by imaging of an aluminium wedge. Only regions with a near constant dose in air were included in the evaluation. Thickness and distance measurements were performed on the CT images.
RESULTS: The thickness of the mandible and compacta showed only small inter-individual differences. A good correlation between film density, tooth roots and compacta, against the distance between root and compacta, could be shown. Measurements in the region of the upper jaw bone did not result in useful data due to superimposition with the palate and lips.
CONCLUSION: Since bone density between tooth roots and compacta is strongly influenced by the distance between root and compacta, and the film density in this region is in good correlation with this distance, it can be concluded that the measured film densities are suitable for determining the bone status of the lower jaw bone.

64 TEMPOROMANDIBULAR JOINT EFFECTS OF ACTIVATOR TREATMENT. A PROSPECTIVE MAGNETIC RESONANCE IMAGING STUDY

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AIM: To assess the effect of activator treatment on the position of the condyle and the articular disc.
SUBJECTS: Thirty Class II division 1 patients treated with an activator.
METHOD: Magnetic resonance images (MRIs) of both temporomandibular joints (TMJs) were taken before and after 1 year of activator treatment. The MRIs were analysed metrically to assess possible changes in the relative position of the condyle, disc and fossa.
RESULTS: None of the subjects exhibited any signs or symptoms of temporomandibular disorder either before or after treatment. On average the articular disc ($P < 0.05$) and the condyle (ns) showed a slightly anterior position relative to the fossa after 1 year of activator treatment. This was probably due to the fact that the Class II jaw base relationship although improved, could not be normalized in all subjects during this short observation period.
CONCLUSION: Activator treatment does not seem to have an adverse effect on the TMJs.

65 ULTRASOUND BONE MEASUREMENT IN ORTHODONTIC PATIENTS WITH CONGENITALLY MISSING TEETH

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AIM: To estimate bone mineral density (BMD) in areas with congenitally missing teeth by the densitometer to predict if the bone is suitable for successful orthodontic/implant therapy.
SUBJECTS AND METHODS: Twenty males and 14 females with congenitally missing teeth (aged between 14 and 27 years) were investigated using the Achilles densitometer. All the patients required orthodontic treatment. Measurements on the os calcis included speed of sound (SOS), broadband ultrasound attenuation (BUA) and a calculated stiffness index. Ultrasound measurements were correlated with BMD of the jaws on the panoramic films and on the TAC to obtain a complete evaluation of bone typology and reproducible and predictable correlations.
RESULTS: A significant correlation between TAC, panoramic film and ultrasound bone measurement was found. BUA showed a correlation with age and was more pronounced in women. There was no significant difference in males and females in SOS values. SOS and BUA values decreased with age in males, while in females SOS decreased with age but not BUA. The stiffness index decreased with age in both sexes. Sex differences for BMD were not significant. In patients whose BUA, SOS and stiffness values were significantly lower than in normal controls, a supplemental

therapy of dietary calcium and vitamin D was administered before or during orthodontic therapy as the bone was not suitable for orthodontic and/or implant therapy.
CONCLUSIONS: The study is preliminary but very encouraging. Continued improvement in ultrasound precision may enhance its applicability to clinical settings. If the results of further investigations confirm these data, ultrasound bone measurement could become the primary examination choice. Ultrasound bone measurement seems to be ideal for orthodontic subjects as it is non-invasive and does not expose the patient to radiation.

66 IMPLANT, PERIODONTAL, AND PROSTHODONTIC CONSIDERATIONS OF NiTi-SE STEEL UPRIGHTING SPRINGS

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AIM: To show the various benefits of molar uprighting from a periodontal, orthodontic, and restorative perspective, and to evaluate the indications, the advantages and disadvantages of NiTi-SE steel uprighting springs. The sequelae of tooth loss are both numerous and varied, increasing in severity with time. Corrective therapeutic measures can become complex both in the diagnosis and treatment of these situations. The need for an interdisciplinary approach within the various areas of dentistry to collaborate in the complex rehabilitation becomes very important.
MATERIALS: This type of spring has been employed to upright 21 molars in 11 patients. A control group of 21 patients was treated using other uprighting systems.
METHODS: The NiTi-SE uprighting spring shows a combination of superelastic material (0.016×0.022 inch titanol) which is linked with a steel wire (0.017×0.022 inch) by means of a crimped connector.
RESULTS: The results show that if an anchoring segment provides the required stability this new uprighting spring is an effective method to upright molars quickly and without periodontal or gnathological problems, unlike other molar uprighting devices.
CONCLUSIONS: In wide areas the pseudoelastic side transfers constant moments and forces to the molars. In addition it is possible to apply intrusive forces over the whole uprighting area by bending and adjusting the steel part.

67 BONE DENSITY VARIATIONS DURING OPEN BITE TREATMENT

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AIM: Comparison of the density of the bones before and 1 or 2 years post-treatment in subjects with an open bite following fixed appliance therapy with vertical elastics.
SUBJECTS: Thirty patients 11–18 years of age with an anterior open bite.
METHODS: The multiband appliance was used in both arches, and during treatment vertical elastics were placed between the brackets in the maxillary and mandibular arches. The elastics were used daily for 4 hours and nightly. Orthopantomograms were taken before treatment and 1 and 2 years post-treatment. The optical density of the maxillary and mandibular bones in the incisor apex area was estimated for 11 patients according to Digora's method. In addition, for all patients, the optical density of the bone in the mandibular angle area (the average density of the left and right sides) was compared with the optical density in the maxillary and mandibular incisor apex area.
RESULTS: Maxilla: In 17 patients an increase of optical density of the bone in the incisor apex area was noted. Nine subjects showed a small tendency to a decrease of density and in four no change was observed. Mandible: An increased density was noted for 17 patients and for nine there was a small tendency to a decrease of density. No changes were observed in four subjects.
CONCLUSION: This method of treatment resulted in relatively small changes in bone structure. Measurement of bone density by optical methods indicated a decrease immediately following treatment but 1 or 2 years post-treatment the bone density shows an increase.

68 A COMPARISON OF FLUORIDE-RELEASING CEMENTS FOR ORTHODONTIC BONDING

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AIM: To compare the shear bond strength of an experimental fluoride-releasing adhesive with a fluoride-releasing light-cured glass ionomer and a composite resin material.
MATERIAL: Forty human molars were bonded with stainless steel orthodontic brackets (Ultra-Minitrim, Dentaurum), using either an experimental light-cured composite resin (Kulzer), Fuji Ortho LC (GC America), Light Bond (Reliance), or 37 per cent phosphoric acid (Kulzer).
METHODS: The teeth were divided at random into four groups of 10 specimens each and mounted in phenolic rings. In Group 1 the teeth were etched and brackets were bonded with the experimental adhesive; the brackets of Group 2 were bonded with Fuji after etching under wet conditions; Group 3 used Fuji on wet enamel surface without etching and in Group 4 the specimens were etched and bonding was performed with Light Bond. All luting agents were used according to the manufacturers' recommendations. The teeth were stored in deionized water at 37ºC for 48 hours. Shear bond strength was determined using a Zwick universal testing machine at a crosshead speed of 1 mm/min. The residual adhesive on the enamel surface was evaluated with a modified Adhesive Remnant Index. The analysis of variance and Duncan's test were used to compare the four groups. Significance was predetermined at $P < 0.05$.
RESULTS: Differences were found between all groups ($P < 0.001$). The mean SBS and (SD) in MPa were: Group 1:

7.26 (1.9), Group 2: 22.08 (3.7), Group 3: 16.94 (2.9), Group 4: 11.65 (2.5). Glass ionomer cement without etching showed adhesive failures at the enamel and good enamel integrity after debonding. The other specimens showed mixed or adhesive at the bracket failures.
CONCLUSION: Glass ionomer used on wet tooth surfaces without etching showed clinically acceptable bond strength with clean separation from the enamel after debonding.

69 SOFT TISSUE PROFILE CHANGES RESULTING FROM ORTHODONTIC TREATMENT WITH EXTRACTIONS

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AIM: To study the modifications of the middle and lower third of the face, during orthodontic treatment of subjects with Angle Class I and Class II division 1 malocclusions.
MATERIALS AND METHOD: Facial profile teleradiographics obtained before and after orthodontic treatment using the edgewise technique with extraction of four first premolars. The subjects were 48 Brazilians, laucoderms, of both sexes, with an age range of 12–17 years. Paired *t*-tests were performed.
RESULTS AND CONCLUSIONS: Analysis of the treatment results showed the following: 1. The upper and lower lips increased in thickness depending on the type of malocclusion. 2. There was no equivalence between retrusion of the upper lip and retrusion of the upper incisor; for the lower lip there was a proportion of 1:1.3. In the age group studied the nose presented a significant increase, independent of the orthodontic treatment. 4. There was a significant increase in soft tissue thickness in the area of point A, while the areas of points B and P did not modify with treatment. 5. Sexual dimorphism was not significant when possible modifications of the facial profile before and after treatment were studied. 6. The absolute values of the thickness of the facial soft tissues were larger in males than females. 7. The nasolabial angle became more open depending on the retrusion of the upper incisors. 8. The facial angle reduced so that the facial profile became less convex, and more harmonic.

70 IS AN IDEAL MOLAR OCCLUSION ALWAYS POSSIBLE?

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AIM: A main objective of orthodontic treatment is to position the upper and lower first molars in an ideal relationship. This entails placement of the cusps of the upper molar in a correct relationship with the buccal grooves and fassae of the lower molar. However, such a relationship may not always be possible due to variations in molar morphology. The purpose of the present study was to assess the variability of upper first molar morphology, in order to determine the feasibility of an ideal molar occlusion.
METHODS AND MATERIALS: Forty upper dental casts were selected at random. All had upper right first molars completely erupted with no restorations and no obvious attrition. The upper right molar of each cast was scanned by placing it on the glass plate of a flatbed scanner, so that at least three of the cusp tips were in contact with the glass. The position of the cusps was digitized from the scanned image. Various measurements were taken, the main one being the mesiodistal position of the mesiobuccal cusp in relationship to the palatal cusps.
RESULTS: The mesiobuccal cusp was found to be, on average, 2 mm mesial to the mesiopalatal cusp. However, a substantial variability was noted. Twenty per cent of all molars had such a morphology, so that if the mesiopalatal cusp were properly positioned in the central fassa of the lower molar, the mesiobuccal cusp would be more than one-fifth a cusp width mesial or distal to the mesiobuccal groove.
CONCLUSIONS: The morphology of the upper molar should be examined before treatment. In some cases it may not be possible to achieve an ideal molar relationship at the end of treatment and it may be necessary to compromise either the position of the buccal or palatal cusps, or the rotation of the molar.

71 THE ORTHODONTIC EFFECT ON ANGLE CLASS II MALOCCLUSIONS AMONG JAPANESE AND CAUCASIANS

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AIM: To investigate cephalometrically the morphological differences among Japanese and Caucasian patients with emphasis on the orthodontic effect in Angle Class II subjects.
SUBJECTS AND METHOD: Thirty eight orthodontic patients of each race from both universities. The Japanese norm for the FMA angle is reported as being 28.5 degrees (Kayukawa) and for Caucasians as 22 degrees (Downs). Japanese patients with an FMA between 22 and 38 degrees and Caucasians with an FMA between 17 and 28 degrees were selected. Cephalometric data from 28 angular and 46 linear measurements were used for computational statistical analysis by *t*-test.
RESULTS: Seven of the 28 angular and 23 of the 46 linear measurements were significant at the 99 per cent level when comparing treatment results. A comparison between males and females showed significant differences in mandibular growth.
CONCLUSIONS: Marked differences were found in the cranial base between Japanese and Caucasians but analysis of denture pattern showed similar changes. Comparisons between male and female mandibular growth showed pronounced but similar differences in both ethnic groups.

72 LONG-TERM CORROSION BEHAVIOUR OF TiN-COATED BRACKETS *IN VIVO*

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INTRODUCTION: Brackets are commonly used in clinical practice. In recent years titanium-nitride was introduced as a coating material to obtain higher surface hardness and corrosion resistance.
MATERIALS AND METHODS: Ultratrimm Brackets 0.022 inch (Roth, Dentaurum) with soldered canine hooks were coated with a PVD-procedure under defined conditions. The resulting coating thickness was approximately 80 µm. The brackets were placed as an orthodontic appliance inside a patient's mouth over a period of 2 years. After removal the brackets were fixed in 2.5 per cent gluterhaldehyde in PBS and air dried. Surface morphology was examined in comparison with new brackets with Environmental Scanning Electron Microscopy (ESEM). The brackets were then embedded in epoxy resin (Araldit 932) and metallographic cuts were prepared. For cut polishing a special solution after Berahja was used.
RESULTS: Especially in the soldered area of the canine bracket surface, changes were observed with ESEM. These changes can be metallographic classified as any small local corrosion elements caused by microscopic holes in the bulk material and lesions of the coating layer in the soldered sector. However, allergic reactions by the patient were not observed.
CONCLUSION: TiN-coated brackets result, especially in areas where some alloys are closely connected, in the creation of local corrosion elements. Although no allergic reactions could be observed, there was no expected surface quality improvement. The employed PVD-coating procedure is not generally suitable for orthodontic treatment of patients with a nickel allergy.

73 ORTHODONTIC TREATMENT NEED, SUBJECTIVE DEMAND AND DENTAL HEALTH IN 8,768 SCHOOLCHILDREN

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AIM: To assess orthodontic treatment need and oral health in a group of schoolchildren between 6 and 16 years of age.
SUBJECTS: The randomized group of 8,768 children was selected from all 65,000 pupils of Dresden (470,000 citizens).
METHODS: The Index of Orthodontic Treatment Need (IOTN) with the two components DHC and AC were used for evaluation. An age-dependent scale was used for selection of such malocclusions which were progredient or inhibit the growth of the jaws, such as mandibular prognathism or crossbite. The OHI/S, DMF/T and intraoral photographs were recorded. All children who had received orthodontic treatment were asked the type of appliance used and the duration of treatment time. They were also asked about their satisfaction with the dental attractiveness. The IOTN was compared with the indication system in Germany.
RESULTS: The responder rate was 95 per cent. The IOTN inclusive step 3 (borderline need) was, at the age of 10 years, 40–50 per cent, and similar to the distribution using the German system. Subjects who had received treatment for prevention of growth inhibition and with a DHC 5 were satisfied with the position of their teeth. The OHI/S was better in orthodontic patients than in untreated children and decreased with higher age. The DMF/T index in patients with orthodontic treatment was a half unit less than in untreated children. There were correlations between the type of breathing and inclination of the incisors.
CONCLUSIONS: The IOTN is suitable for measurement of treatment need. The subjective demand for orthodontic treatment by schoolchildren is less than the objective need.

74 THREE-DIMENSIONAL CEPHALOMETRIC ERROR ANALYSIS USING THE DIGIGRAPH™ WORKSTATION

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AIM: To determine the reliability of three-dimensional (3D) cephalometric measurements, the following were investigated a) the reproducibility of 3D co-ordinates, b) the reliability of cephalometric landmarks in three dimensions and c) the validity of linear measurements recorded in three dimensions.
SUBJECTS/MATERIAL: Twenty adult volunteers, one dried skull and a DigiGraph™ workstation.
METHOD: A new computer program to enable the research to be undertaken was written using the C programming language. The digitizing handpiece was attached to a photographic tripod. On three different days a right, central, and left position were digitized. The pooled standard deviations of these co-ordinates were calculated. Twenty landmarks were digitized and, according to the method developed by Baumrind to investigate two-dimensional landmark reproducibility, five measurements were obtained for each patient. The calculated midpoints of the resulting 5-point clouds were superimposed to 100-point clouds for each landmark. The landmarks' standard deviations were calculated. Eleven landmarks were digitized 10 times on 3 days by one examiner. Selected distances were calculated by the developed software. For comparison the same distances were recorded by three examiners 10 times using an anthropologic calliper. Mean values and standard deviations were determined and *t*-tests for independent samples were performed.
RESULTS: The co-ordinate reproducibility varied from 0.08 to 0.17 mm in different locations. The greatest scatter could be observed for left gonion with a standard deviation of 1.98 mm sagittally. Right machine porion proved to be the most consistent with a standard deviation of 0.51 mm vertically. Head rotation was not an important influencing

factor. The linear measurements obtained with the DigiGraph™ deviated 0.01–1.19 mm from the corresponding measurements. The distance between right and left porion differed by 2.69 mm.
CONCLUSIONS: The collected 3D data were valid and reproducible in the described setting.

75 THE PROGRESSIVE REPOSITIONING ACTIVATOR IN THE TREATMENT OF CLASS II DIVISION 1 MALOCCLUSIONS

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AIM: To investigate the effects of a progressive activator in the treatment of subjects with Class II division 1 malocclusions.
PATIENTS: Twenty males and 24 females of the Europoid type aged 9–13 years with a Class II division 1 malocclusion treated successfully with the progressive repositioning activator (improvement of at least half a cusp of a premolar).
METHOD: The activator is a tissue-borne appliance consisting of two splints. Two lingual wings induce mandibular propulsion. The lower incisors are covered with acrylic for improved control. The splints are bonded together after determination of the appropriate position of the mandible and readjusted into a more anterior position every 5–6 months. The treatment consisted of three consecutive stages of forward mandibular induction. The appliance was worn only during the night. No extra oral forces were used. Thirteen cephalometric angular variables, stable with growth, were compared before and after treatment by paired *t*-tests.
RESULTS: Mean treatment time lasted 14 months (SD = 2.5). No changes were found for cranial base, gonial, mandibular plane or occlusal plane angles. Mean SNA decreased from 81.5 to 80.7 ($P < 0.01$), SNB increased from 74.2 to 76 ($P < 0.01$) while SNPog increased to a lesser extent from 75.9 to 77.2 ($P < 0.01$). ANB changed from 7.3 to 4.7 ($P < 0.01$), 1/NL decreased from 113.2 to 109.2 ($P < 0.01$) while i/PM increased from 97.8 to 102.3 ($P < 0.01$).
CONCLUSIONS: The treatment of Class II malocclusions with a progressive activator is associated with favourable dentoalveolar modifications in both jaws and with a probable orthopaedic effect on the mandible (increase of SNPog). No unfavourable changes were seen for either mandibular or occlusal plane. The progressive activator is a comfortable appliance with a good indication in Class II mesodivergent patients.

76 HISTOCHEMISTRY OF THE RETARDED MOVEMENT AND FUSION OF THE PALATINE PROCESS IN RABBITS

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AIM: To elucidate the controversy in the literature on the development and fusion of the facial process and palate.
MATERIAL: Twenty eight rabbit foetuses at day 20–29 with clefts of the secondary palate.
METHODS: Clefts were reproducibly induced in white Russian rabbits after treatment of the dama with cyclophosphamide (12–15 mg/kg body weight) during gestation (days 11 and 12). The heads were fixed in 3 per cent buffered formaldehyde and embedded in paraffin. Serial sections of coronal slices were cut. In addition to routine staining, immunohistochemistry was applied using monoclonal antibodies against KI 67 (MIB-1, Dianova, Vimentin (DAKO) and Pancytokeratin (DAKO). Apoptosis was detected by labelling the 3 OH-ends of the fragmented DNA.
RESULTS: Development of the palatinal shelves was reduced in 20 animals. In eight animals fusion or partial fusion was observed. The covering epithelium consisted of squamous epithelium with acanthosis adjacent to the transition area. In specimens where only one palatinal process was fused, because of embedding of the tongue, the covering epithelium was reduced to one layer. At the fusion site numerous apoptotic cells were found with simultaneous mitosis in the underlying layer. The subepitheal basal lamina was only partially preserved indicating mesenchymal penetration. Fusion was missing in specimens where overgrowth or reduced growth of the nasal septum and/or palatinal shelves were observed.
CONCLUSION: In cyclophosphamide treated animals fusion of the palatinal shelves with the nasal septum is retarded. An important step in palatinal fusion may be the reduction in epithelial activity in combination with apoptosis together with normal development of the palatinal processes.

77 TENSILE STRENGTH AND STRUCTURAL TRANSFORMATION OF LASER WELDED JUNCTIONS

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INTRODUCTION: Laser welding of orthodontic wires offers the possibility to connect stainless-steel alloys without using foreign materials. The question therefore arises under what conditions the best possible connection is achieved and what kind of microstructural changes might appear at the welding seam.
MATERIAL AND METHOD: The laser welding was carried out using a Heraeus Haas Laser 44 P (Nd:YAG). The material used was the cold-hammered wire Remanium®, Dentaurum Company, with a strength of 0.8 mm. Applying 1.2 mm as the constant focus size, a seven step modification of the pulse intensity was applied during pulse durations of 10 and 16 ms each. For every combination of parameters, six trials each were applied in the tensile test. Additionally, the structural constitution was analysed in the metallographic micrograph after etching by differential-interference-phase-contrast-microscopy and by Vickers hardness test.

RESULTS: The results of the tensile test showed that for each pulse duration an optimal pulse intensity existed with regard to the maximal tensile strength. An increased divergence of the pulse intensity from this optimum always led to an increased reduction of the maximal tensile strength. A typical appearance of the welding seam correlated with this optimum, whereby the visual appearance deteriorated when the values of tensile strength decreased. Dependent on the tensile strength, recrystallization processes were detected in the micrograph as well as changes in the crystal structure in the non-cast part after laser welding. The Vickers hardness in the welding seam was reduced.
CONCLUSION: It was established that for fabrication of an optimal laser welding seam in wires, a suitable combination of the parameters, focus size, pulse duration and pulse intensity is necessary corresponding to the typical appearance of the welding seam. Because of the laser bombardment, changes in the material appear in the melting range as well as in its surrounding area.

78 IMMEDIATE REPROCESSING OF FAILED ORTHODONTIC BRACKETS

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AIM: *In vitro* evaluation of reprocessed accidentally debonded brackets.
MATERIAL AND METHOD: One hundred and twenty extracted human teeth were randomly divided into two groups of 60. In one of the groups mesh-based brackets (Ultra-Minitrim®; Dentaurum, Germany) were bonded with Bona-Bond plus® (BonaDent, Germany) and the other group used Transbond XT® (Unitek, USA). After 48 hours' storage the initial shear bond strengths were measured with a testing machine (Zwicki 1120; Zwick, Germany). After the testing procedure each group was divided into four subgroups of 15 teeth. The bases of the debonded brackets in the subgroups were prepared by the following methods: 1. No preparation; 2. Removing the residual adhesive by a tungsten-carbide bur; 3. Burning off the resin with a flame; 4. Removal of the adhesive by sandblasting. The residual resin on the teeth was removed with a tungsten-carbide bur and the reconditioned brackets were rebonded with the specific adhesive. After 48 hours' storage the shear bond strengths were tested again. The mean values and standard deviations of the shear bond forces were reported in megapascals of pressure (MPa) and an analysis of variance was used to compare the results.
RESULTS: Mean ± S.D. (MPa): T1 = initial bond strength, T2 = bond strength

	BonaBond T1	BonaBond T2	Transbond T1	Transbond T2
1 no preparation	11.44 ± 0.65	7.91 ± 1.31	12.31 ± 0.70	5.63 ± 2.73
2 tungsten-bur	11.48 ± 0.66	6.31 ± 2.42	12.29 ± 0.68	4.70 ± 2.44
3 flame	11.43 ± 0.63	8.44 ± 2.91	12.36 ± 0.71	2.31 ± 0.85
4 sandblasting	11.34 ± 0.61	12.02 ± 1.50	12.25 ± 0.74	11.03 ± 2.97

The reconditioning procedure had a statistically proven influence on shear bond strength.
CONCLUSION: Sandblasting the mesh base of an accidentally lost orthodontic bracket is a useful method to reutilize the same attachment.

79 SHAPE ANALYSIS OF THE FACIAL SOFT TISSUE CHANGES FOLLOWING ORTHOGNATHIC SURGERY

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AIMS: To examine changes in the shape of the soft tissues following orthognathic surgery to correct Skeletal II and III malocclusions.
SUBJECTS: Seventy five adult Caucasian patients, 34 Skeletal II, 41 Skeletal III.
METHODS: Optical surface scans were obtained of the patients immediately pre-operatively and at least 1 year post-operatively. The data obtained were analysed using surface shape analysis, a mathematical method for describing three-dimensional (3D) surface shape. Gaussian and mean curvatures were calculated for each data point, and used to classify the point as belonging to one of nine surface shapes, distinguished by colour. The resultant image produced allowed a qualitative description of changes in the facial soft tissues following surgery.
RESULTS: All the groups exhibited shape change distant to the immediate area involved in surgery; mandibular only surgery demonstrated marked changes over the maxilla, and bimaxillary subjects demonstrated changes over the zygomatic arch and at the tip of the nose. The soft tissues at and around many landmarks used for surgical prediction, such as soft tissue, point A, point B, Labrale Superius, Labrale Inferius and soft tissue Pogonion, underwent shape change.
CONCLUSIONS: Surface shape analysis was found to provide a meaningful qualitative description of the soft tissues, allowing simple comparison between pre- and post-operative patients and greater understanding of 3D soft tissue changes that occur following surgery. Surgery has widespread effects on the facial soft tissues, not just limited to the immediate area involved. Soft tissues landmarks are prone to shape change which could thus lead to inaccuracies with prediction of surgical changes, directly by the landmark changing shape or indirectly due to errors in landmark placement leading to it being located on a different surface shape.

80 DESCRIPTION OF LONGITUDINAL CEPHALOMETRIC MEANS ON THE SAGITTOMETER OF THE BRACS SYSTEMS

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AIM: To test the accuracy of the cephalometric BRACS analysis.

MATERIAL: Data from the University of Michigan School Growth Study.
METHODS: Twenty two cephalometric polygons, 11 for girls and 11 for boys aged 6–16, were constructed trigonometrically on the co-ordinate system (sagittometer) of the BRACS using age-specific means of nine linear measurements. The sagittal apical base difference (ratio Tbs) in each polygon was computed. The conformity between the obtained 22 age-specific means for Tbs and the 22 original age-specific means for the ANB angle was tested by means of the correlation analysis.
RESULTS: The coefficient of correlation between the measurements Tbs and ANB was r = –0.976. The original data were approximate estimates. It was thus possible that the results of the trigonometric calculations could be somehow erroneous. To evaluate the error, the original and computed means for ANB were compared with each other. The mean error was 0.06 degrees.
CONCLUSION: Mean growth changes in the sagittal apical base relationship can be measured, recorded and visualized on the sagittometer of the BRACS.

81 IMAGE QUALITY IN THREE-DIMENSIONAL COMPUTED TOMOGRAMS OF THE FACIAL SKELETON CONSIDERING THE EXPOSURE DOSE

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AIMS: 1. To reduce the radiation of computed tomography (CT) scans in comparison with the hitherto used exposure dose. On this occasion the three-dimensional (3D) reconstructions should retain optimal image quality and the radiological diagnosis should not be compromised. 2. To determine the optimal parameter settings for 3D-reconstructions for clinical application.
MATERIAL AND METHODS: Twenty four spiral CT-examinations of phantom skulls were performed on a Siemens Somatom Plus 4A scanner, including 3D images. The scan parameters varied in slice thickness, feed/rotation (pitch), rotation time, kV and mA. Additionally the CT dose index (CTD1 in mGy) was calculated for each scan central (point A) and at the surface (point B). Students and residents of dentistry as well as radiologists evaluated anonymous 3D images with 24 different scan parameters for image quality. Based on these results CT-scan parameter could be optimized for patient examination.
RESULTS: This experimental study showed a reduction in exposure dose at point A from 16–36 mGy to 1.9 mGy, and at point B from 24–48 mGy to 3.6 mGy with constant image quality. A further reduction in exposure dose to 1.3 mGy at point A and 2.2 mGy at point B provided acceptable, but not optimal image quality. Further reductions of exposure dose resulted in clinically unacceptable images.
CONCLUSIONS: By specific choice of the determined parameter settings, a dramatic reduction of radiation exposure in CT-studies can be achieved. The results can be directly translated into clinical application.

82 THE ORTHODONTIST'S CONTRIBUTION TO THE MANAGEMENT OF OBSTRUCTIVE SLEEP APNOEA

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AIMS: To investigate 1) the influence of posture on upper airway dimensions and 2) the efficacy of mandibular advancement splints in subjects with obstructive sleep apnoea (OSA).
SUBJECTS: Thirty seven male Caucasian adults with mild to moderate OSA.
METHOD: Three lateral skull radiographs were obtained: upright in occlusion, supine in occlusion and supine in protrusion. Radiographs were traced and digitized and changes in mandibular position, airway dimensions and hyoid position were evaluated. Pre- and post-treatment questionnaires were completed in conjunction with the fitting of a Herbst mandibular advancement splint.
RESULTS: Between the upright and supine films in occlusion, mean reductions in minimum post-palatal and post-lingual airways of 2.3 mm ($P < 0.001$) and 1.6 mm ($P < 0.05$) respectively, were seen. Highly significant increases occurred in tongue proportion (44 per cent) and soft palate area (2.2 mm). In the supine position, the following changes were observed when the mandible was postured forwards: the minimum distances between the posterior pharyngeal wall, the soft palate and the tongue increased by 0.7 mm and 1.4 mm respectively, while the oropharyngeal area increased by 0.9 mm^2 ($P < 0.05$). After an average period of 13.4 months, 28 subjects (76 per cent) reported the splint to have been effective in relieving their symptoms with no serious side effects.
CONCLUSIONS: 1) Significant changes in airway dimensions accompany an alteration in posture from the upright to the supine position. Thus the airway in OSA subjects should be evaluated in the supine position. 2) In a sample of 37 subjects a compliance rate of 76 per cent was obtained with an improvement in clinical symptoms and no serious complications.

83 A VALIDATED MODEL OF TOOTH MOVEMENT

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AIM: To develop a validated computer model of time-dependent tooth movement.
MATERIALS AND METHOD: The model: A 15,000 noded three-dimensional (3D) Finite Element Model of

human maxillary incisor tooth movement was developed using MSC/Patran software. Initial morphological data were collected from the Human Visible Project (Viewpoint Datalab, Orem. USA), and initial physical properties of soft- and hard-tissues was, in the first instance, based on historical data (Wilson *et al*., 1992). Considerable attention was paid to the modelling of the periodontal ligament (PDL) which was attributed viscoelastic behaviour. The validation: A novel laser-based measurement apparatus was developed to accurately chart tooth movement in human volunteers. The apparatus moves with the subject's head and has previously been demonstrated to be accurate to 0.001 mm with a sampling cycle of 0.01 seconds. Ten subjects were measured 5 times over a 2 minute cycle and the results collated.
RESULTS: The experimental results demonstrated fair intra-observer reproducibility but showed significant differences between subjects. The range of tooth displacement recorded was 0.012–0.134 mm for a typical constant (orthodontic) load of 0.39 Newtons. The displacement under load was very sensitive to factors such as disease and age. Physical properties for the PDL were derived for the human PDL by direct measurement. As a result, a value of 1 N/mm^2 for elastic modulus and 0.42 for Poisson's ratio were applied to the computer model. The greatest PDL strain predicted in the computer model was at the alveolar crest reaching a peak of 4.77×10^{-3}, whilst the largest value of apical PDL strain was 1.55×10^{-3}. The maximum principal strains seen in the alveolar bone adjacent to the ligament were 35 times less (1.4×10^{-4}). Elsewhere in the bone, strains approached zero.
CONCLUSIONS: The experimental-based approach to validating a time-dependent computer model of tooth movement has been demonstrated to be valid. A process for direct measurement of PDL properties has been described. These results would support the contention that the PDL is the main mediator of orthodontic tooth movement. The new numerical model marks a further step towards a valid computer-based method with which to test and develop biomechanical systems.

Wilson A N, Middleton J, Jones M L 1992 Interfaces in medicine and mechanics. Dotesius Ltd., UK

84 PREDICTION OF CRANIOFACIAL GROWTH IN UNILATERAL CLEFT LIP AND PALATE PATIENTS

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AIM: To compare the actual facial growth in unilateral cleft lip and palate patients (UCLP) with a computer projected forecast from the pre- to the post-pubertal developmental phase.
MATERIAL: Ninety five lateral cephalograms of 22 UCLP subjects (17 males, 5 females) were analysed. All patients had undergone the same surgical treatment at Albert-Ludwigs University, Germany. The radiographs were taken at six time-points (T1 x = 7.6 years, T2 x = –10.2 years, T3 x = 12.3 years, T4 x = 14.6 years, T5 x = 16.3 years, T6 x = 17.4 years). In most of the subjects the observation interval between two cephalograms was approximately 2 years.
METHODS: For each subject a growth forecast was performed from the initial radiograph over different time periods. The interval of the individual growth prediction corresponded to the time difference between two head plates of the single case. The computergenerated forecasts (Quick Ceph Image©) according to the method of Ricketts (1988) were compared with the cephalograms and the clinical standards. The data were statistically analysed and group differences assessed using the Wilcoxon test.
RESULTS: At T1 the UCLP patients showed a retrognathic dentofacial morphology, a Class II intermaxillary relationship, and a slight vertical growth pattern. With increasing age a significant lack in maxillary growth occurred ($P < 0.05$). Soft tissue convexity was increasingly reduced and a skeletal Class III pattern developed. The growth increments of the anterior cranial base and the mandibular body were within the range of clinical standards. However, compared with the forecasts, the pubertal increase in mandibular length occurred at a later time-point. The most significant growth changes were observed between T4 and T5.
CONCLUSION: Growth forecasts routinely used in orthodontics cannot be applied to UCLP patients. This group show specific growth increments which differ in size and time-point from the average population. Further comparative studies are necessary to establish an individual growth prediction for UCLP patients.

85 ACCURACY OF POSITIONING THREE BRACKET SYSTEMS BY OPERATORS WITH DIFFERENT LEVELS OF EXPERIENCE

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AIM: To determine the degree of accuracy in placement of three bracket systems of different sizes and morphology, by a direct bonding technique, attainable by qualified dental nurses after a limited period of training and to compare them with operators already experienced in the preadjusted edgewise system.
SUBJECTS AND METHODS: Twenty subjects (5 consultants, 5 specialist practitioners, 5 higher trainees, 5 qualified dental nurses). Three bracket systems large (FSTIB, 3M Unitek), medium (Mini Uni-Twin, 3M Unitek) and small (Miniature Twin, 3M Unitek). Three identical typodonts, set to a Class II division 1 malocclusion, were mounted within mannequin heads which were fixed on to a dental chair to replicate the clinical situation. The qualified dental nurses were trained in bracket positioning using a 15-minute video.

Each operator carried out three consecutive bond-ups using large, medium and small brackets. Accuracy of bracket positioning was determined using a computerized image analysis system. The horizontal, vertical and angular displacements from the ideal were measured.
RESULTS: There was significant inter-bracket variability, with the large brackets significantly better positioned than the medium and small brackets. All four operator groups performed better in placing large brackets. Bracket placement proved most difficult in the angular placement. There was no relationship between operator experience and the accuracy of bracket placement.
CONCLUSION: Bracket size and morphology influenced the accuracy of bracket positioning. Operator experience did not influence the accuracy of bracket positioning.

86 LONGITUDINAL OVERBITE CHANGES CONTROL THE STRATEGY FOR ORTHODONTIC TREATMENT

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AIM: To evaluate the appropriate strategy for orthodontic treatment, including the timing, from the point of view of longitudinal changes of incisal occlusion.
MATERIALS AND METHODS: Seventeen hundred and eight intraoral plaster models were impressed from 444 traditional Australian Aborigines, without any dental treatment, in four age groups (7–9, 11–12, 14–16 and 17–20 years of age). Five typical cases of each age group from each type of incisal changes (normal to deep overbite, edge-to-edge occlusion, open bite, and deep overbite, open bite to normal occlusion) were first selected. Each of them were then analysed by measuring the overjet, the overbite, and the inclination of the central incisors. The outline of each tooth traced from photographs of each age of plaster models was also superimposed which had one case selected from the five typical cases.
RESULTS: 1) In the case of changes from malocclusion to normal incisal occlusion, deep overbite was reduced to normal incisal occlusion at 15–18 years of age, whereas in both edge-to-edge occlusion and open bite transition occurred at the age of 8–11 years. 2) In the case of changes from normal incisal occlusion to malocclusion, transition to deep overbite occurred at the age of 8–11 years, transition to edge-to-edge occlusion took place at the age of 11–15 years and transition to open bite occurred at the age of 15–18 years. 3) A common phenomenon in all cases (normal to malocclusion and malocclusion to normal occlusion) was the reduction in overbite during development.
CONCLUSION: Appropriate strategy for orthodontic treatment, including timing, depends on the types of malocclusions from the point of view of the longitudinal changes of the overbite.

87 THE ACCURACY OF CEPHALOMETRY IN THE INTERPRETATION OF TREATMENT RESULTS

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AIM: To determine the error involved in landmark identification and to correlate it with the interpretation of treatment results.
MATERIAL: Fifty randomly selected cephalograms.
METHODS: 1. Accuracy test of the digitizer (DIGI-PAD controller Type 5A, GTCO Corporation): one tracing was digitized five times at 10 different positions of the digitizer by one observer. 2. Intra- and inter-observer digitizing error: 35 landmarks of the same tracing were digitized five times each by four different judges (on a fixed position). 3. Intra-observer tracing error: 50 cephalograms were traced five times each by one investigator and digitized. 4. Inter-observer tracing error: 10 different cephalograms were traced five times each by four different judges.
RESULTS: There was no significant difference among the variances of the co-ordinates of each of the landmarks on the different locations of the digitizer. The variance in digitizing was also comparable for each of the landmarks: 0.07 mm for the *x*-axis and 0.08 mm for the *y*-axis. The one-way ANOVA test showed no significant differences among the investigators for the digitizing procedure. When considering the intra-observer tracing error, there were important significant differences between the variances of the co-ordinates of each landmark, indicating that the tracing accuracy of some landmarks is an important limiting factor to consider in cephalometrics. Moreover, the variance of each landmark was also dependent upon the studied cephalogram. When considering the inter-observer tracing variance, a two-way ANOVA test showed greater differences between the measured co-ordinates of the landmarks. No systematic errors made by one investigator were involved.
CONCLUSIONS: Since Baumrind and Frantz (1971) suggested that the result of therapy in an individual patient should be at least twice the standard deviation of the estimated error, the error involved in landmark recording is an important factor to be considered in the interpretation of treatment results.

88 THE ROLE OF OCCLUSAL CHARACTERISTICS IN PREDICTING ORTHODONTIC TREATMENT DURATION

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AIM: PAR component scores have explained 57 per cent of variability in anticipated treatment duration (DeGuzman *et al*., 1995). The aim of this study was to validate the published PAR treatment time prediction equation.
MATERIAL: Orthodontic models and treatment records from a sample of 86 patients < 20 years old treated

non-surgically with a single phase of fixed appliances by one clinician at Mayo Clinic between 1990 and 1997.
METHODS: All models were scored for individual PAR components. These component scores were used in the published PAR treatment time prediction equation to estimate treatment duration. Actual treatment time was calculated by subtracting from total treatment duration (appliance placement to appliance removal), the number of weeks between scheduled but missed appointments and the next actual visit. The anticipated treatment time was compared with actual treatment time using Spearman's rank correlation coefficient.
RESULTS: Sample characteristics: 55 per cent females, 45 per cent males; mean age 13.4 ± 1.7 years; mean initial PAR = 21.8 ± 8.4. The mean PAR predicted treatment time was 8.2 ± 1.9 months; mean actual treatment time was 13.4 ± 4.3 months. The equation predicted 8.9 per cent of the variability of the actual treatment time in this sample. The correlation between PAR predicted and actual treatment time was 0.37 ($P < 0.05$).
CONCLUSION: The predicted treatment time derived from PAR components explains less variability in this sample (8.9 per cent) than described in the investigation which developed the prediction equation (57 per cent). These results suggest that occlusal factors as scored by the PAR index may play a smaller role in treatment time than previously reported.

DeGuzman L, Bahirael D, Vig K W L, Vig P S, Weyant R J, O'Brien K D 1995 The validation of the Peer Assessment Rating Index for malocclusion severity and treatment difficulty. American Journal of Orthodontics and Dentofacial Orthopedics 107: 172–176

89 ORTHODONTIC TREATMENT NEED IN TREATED AND UNTREATED YOUNG FINNISH ADULTS

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AIM: To evaluate orthodontic treatment need and patient satisfaction in relation to the history of orthodontic treatment in young adults from an area where free-of-charge interceptive orthodontic care was provided to adolescents.
SUBJECTS: A total of 281 18–19-year-old subjects, comprising 70 per cent of the sample, were randomly selected from the population register of Vantaa in Finland.
METHODS: Treatment need was assessed clinically according to the Index of Orthodontic Treatment Need (IOTN), consisting of a Dental Health Component (DHC) and an Aesthetic Component (AC). Information of a history of orthodontic treatment and the type of appliance was based on the patient records. All subjects answered a questionnaire regarding satisfaction with their dental appearance and with the orthodontic treatment received.
RESULTS: Forty six per cent of the subjects (54 per cent females and 37 per cent males, $P < 0.05$) had received some orthodontic therapy during adolescence. The frequency of discontinued treatments was 4 per cent. Interceptive orthodontics with headgear and quadhelix were widely applied. Fixed appliances were used in 36 per cent of the treated cases. DHC grades 4–5, indicating definite need for treatment, were assessed in 13 per cent of the subjects, and DHC grade 3, indicating borderline/moderate need, in 35 per cent. No difference in the DHC score was found between the treated and untreated subjects ($P = 0.834$). Females had significantly more often no or little treatment need (DHC 1–2) compared with males ($P < 0.05$). The majority of the subjects (89 per cent) stated that they were very or rather satisfied with their dental appearance. The odds of being satisfied were significantly higher for the treated subjects (OR = 2.90, $P < 0.05$) and for those at the attractive end of the AC scale (OR = 7.42, $P < 0.01$). Neither gender nor DHC affected the odds of being satisfied among the subjects.
CONCLUSION: The frequency of orthodontic treatment, especially in females, is higher than previously reported. The objective treatment need is similar in young adults with and without a history of orthodontic treatment at adolescence. However, satisfaction with dental appearance is positively affected by orthodontic treatment.

90 FUSION OF THE DISTAL PHALANX OF THE THUMB—CLINICAL SIGNIFICANCE

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AIM: To determine the reliability of fusion of the distal phalanx of the thumb as a skeletal maturity indicator (SMI).
MATERIAL: Hand-wrist radiographs of 32 Class I, 29 Class II and 19 Class III females.
METHOD: Eighty subjects were grouped into three malocclusion groups according to lateral cephalograms. Hand-wrist radiographs were taken at six-monthly intervals and SMI at fusion of the distal phalanx of the thumb, according to Fishman, was evaluated. Menarcheal age was asked during the clinical examination. Paired *t*-tests and ANOVA were performed.
RESULTS: Fusion of the distal phalanx of the thumb occurred at an earlier age for the Class III malocclusion group than for Class II and Class I. The ages were 12.95 ± 0.77 for Class I, 13.34 ± 0.95 for Class II and 12.67 ± 0.70 for Class III. The average SMI stage was 8.63 ± 0.54 and no significant difference was found among malocclusion groups. The Class II malocclusion group showed a higher menarcheal age than Class I and Class III. Fusion of the distal phalanx of the thumb occurred 0.53 ± 0.52 years later than menarche and showed significant differences at the $P < 0.05$ level.
CONCLUSION: Fusion of distal phalanx of the thumb and menarcheal age are closely related and are both useful for skeletal maturity evaluation.

91 OCCLUSAL PATTERNS OF MALOCCLUSION USING THE OCCLUSAL FORCE MEASURING SYSTEM—PART 2

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AIMS: The diagnosis associated with occlusal contacts is the key to evaluating the efficacy of orthodontic treatment. Recently a novel occlusal diagnostic system (Dental Prescale Occluzer System) has been developed.
MATERIALS AND METHODS: This study was designed to investigate occlusal contact areas and pressure in occlusion using this system in normal subjects and those with malocclusion, the seven facial patterns, and in patients during the retention period. The results from the initial study have been presented (Kitafusa, 1998).
RESULTS: In occlusal facial patterns, a severe brachyo pattern was the widest at 9.69 mm^2 in occlusal contact area, and the highest at 457.28N in occlusal force. The occlusal contact area and occlusal force of the other facial pattern groups were in the following order: from brachyo pattern, mesio tendency to brachyo, mesio pattern, mesio tendency to dolicho, dolicho pattern, severe dolicho pattern. On average the occlusal pressure of the subjects with a dolicho pattern was highest at 56.08 MPa, but there were no significant differences between each facial pattern. In patients in the retention period, the passage of retention time in many cases led to higher values of occlusal contact areas and occlusal forces.
CONCLUSIONS: Considering the circumstances mentioned above, this system provides reliable results and data for measuring occlusal patterns.

Kitafusa Y 1998 Occlusal patterns of malocclusion using the occlusal force measuring system. European Journal of Orthodontics 20: 620 (Abstract)

92 DIRECT BONDING TO PORCELAIN WITH RESIN-REINFORCED GLASS-IONOMER CEMENT

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AIM: To determine the bond strength of a resin-reinforced glass-ionomer cement (RGIC) when used to bond mesh-backed brackets to porcelain.
MATERIALS AND METHODS: One hundred and eighty porcelain discs with a diameter of 10 mm were prepared from G-Cera (GC Corp., Japan). Progressively finer polishing of the ceramic surface was performed with 120–1000 grit waterproof abrasive paper. Three bonding agents were used: bis-GMA based composite resin (Concise, 3M-Unitek, USA), chemically-cured RGIC (Fuji Ortho, GC Corp., Japan) and light-cured RGIC (Fuji Ortho LC). The porcelain surfaces to be bonded were prepared with an application of 37 per cent buffered phosphoric acid for 20 seconds and silanated with Cosmotec II Primer (GC Corp.). Tensile and shear bond strengths were examined.
RESULTS: The light-cured RGIC and composite resin groups showed greater tensile bond strength than the chemically-cured RGIC group. The composite resin group showed greater shear bond strength than the chemically- and light-cured RGIC groups. No significant differences in shear bond strength were found between the chemically- and light-cured RGIC groups.
CONCLUSIONS: Although the bond strength of RGIC was less than that of the composite bonding medium, it appears to be adequate for clinical use.

93 DEVELOPMENT OF A THREE-DIMENSIONAL MODELLING SYSTEM UTILIZING POSTERO-ANTERIOR AND LATERAL CEPHALOGRAMS

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AIM: To develop a three-dimensional (3D) modelling system of the craniofacial complex utilizing postero-anterior (PA) and lateral cephalograms.
MATERIAL: PA and lateral cephalograms taken from a human dry skull.
METHODS: The 3D modelling process was carried out using specifically developed software. The basic model of the mandible was reconstructed as a computer graphic and utilized in the following steps: Cephalometric films were scanned and their images were imported into a computer. The mandibular model and cephalometric images were simulated to locate in a similar 3D co-ordinate system, referring to the ear rod and the centre of the X-ray beam. The co-ordinates of the conventional landmark points on the PA and lateral images were detected on the monitor. From the corresponding landmark points in each image, their 3D co-ordinates were calculated and utilized to reshape the basic mandibular model. This 3D model was projected into 2D models on each screen of PA and lateral cephalograms. The obtained 2D models were superimposed on their radiographic images and reshaped more precisely to fit on the contour of the mandible. This process was accomplished by trial and error, and these 2D models were reconstructed into a 3D mandibular model again. Using the co-ordinates of the 3D mandibular model, angular and liner measurements were made and the results were compared with the corresponding results directly measured on the dry skull by the 3D digitizer.
RESULTS: A 3D modelling system of the mandible from PA and lateral cephalograms was developed. Measurement error was acceptable.
CONCLUSION: This system seems to be useful to carry out 3D measurements and diagnosis, with little expense and a reduction in radiographic exposure.

94 COMPUTER-AIDED THERAPY OF CRANIOMANDIBULAR DISORDERS BY THE CONDYLE-POSITION-SIMULATOR

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AIM: To demonstrate ways in which the therapeutic three-dimensional (3D) position of the temporomandibular joints can be programmed by a computer-aided system, to demonstrate the easy handling of occlusal splints and orthodontic appliances and to introduce a new condyle-position-simulator (CPS)
SUBJECTS: Twelve patients with craniomandibular disorders (CMD) and 8 patients receiving functional appliances were treated using the CPS.
METHODS: Occlusal splints are well-known in the therapy of functional disturbances of the craniomandibular system (CMS) but to the present time 3D therapeutic positioning of the condyles has been carried out without using detailed reproducible protocols. Using a centric recording does not allow correct reproduction of the condyle positions. With the aid of the CPS, therapeutic positions of the lower jaw can be programmed three-dimensionally with the assistance of a computer. Therefore the possibility to assess therapeutic positions and change treatments can be carried out at any time during treatment. In addition the system can be used in the therapy of functional disorders and functional appliances can be constructed with the help of the CPS.
RESULTS: The programming of the CPS and the construction of bite plates together with 3D-data showing the differences in the therapeutic positions to maximal intercuspation will be demonstrated. Observations will be given on the relationship of the condyle and fossa in radiographic analysis, which was performed simultaneously. Case histories will demonstrate the effectiveness of this new therapeutic tool. Furthermore, the change in condyle positions using check bites for planning functional appliances will be explained.
CONCLUSION: The CPS allows new possibilities of programming and controlling functional therapy.

95 CHANGES IN THREE-DIMENSIONAL CONDYLAR POSITION DURING SPLINT THERAPY

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AIM: To demonstrate changes in the three-dimensional (3D) position of the temporomandibular joints (TMJs) during splint therapy and to introduce a new computer-based instrument for analysing the position of the condyles [Condyle-Position-Analyser (CPA)].
MATERIAL: The 3D condyle position of 24 patients with craniomandibular disorders (CMD) was monitored for diagnostic purposes and during splint therapy.
METHODS: With the CPA the *x*- *y*- and *z*-dimensions of the condyles were registered for diagnostic purposes at the beginning of therapy and at every control period. The 3D-data were stored in a computer (Excel 97, Microsoft Corp.) and calculated using the SPSS 7.6 program (SPSS Inc.).
RESULTS: In the first part of the investigation the 3D-data of the condyle positions concerning maximal intercuspation and centric relationship were recorded. The mean axes differences found were: *x*- (horizontal) 1.8 mm, *z*- (vertical) 1.1 mm and *y*- (transversal) 0.8 mm. During treatment with occlusal splinting, without physiotherapy or orthopaedic therapy, this position changed dramatically. In the treatment period the bite plates were adjusted weekly. All splints were remounted in the Girirbach-Reference® Articulator (modification according to Kopp and Burckhardt). Surprisingly most of the patients returned almost to the *x*- *y*- *z*-position of the original centric recording, achieved at the very beginning of therapy, when they were pain-free. With the help of the CPS the final reconstruction can easily be undertaken.
CONCLUSION: Detailed knowledge of condylar position is important in the treatment of CMD. The CPA makes it easy to understand and document 3D condylar changes before and during therapy. The articulator system used is compatible with others and to the CPA and CPS. Final treatment, orthodontic or prosthetic, has become very easy in daily practice.

96 MANDIBULAR ROTATION COMPONENTS IN HIGH- AND LOW-ANGLE HERBST PATIENTS

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AIM: To assess the short- and long-term influence of Herbst treatment in high- and low-angle Class II malocclusions with respect to total, matrix and intramatrix rotation of the mandible (Björk and Skieller, 1983).
SUBJECTS: Thirteen high-angle (ML/NSL ≥ 37) and 17 low-angle (ML/NSL ≥ 26) Class II malocclusions treated with the Herbst appliance.
METHOD: Analysis of lateral headfilms from before and after 7 months of Herbst treatment as well as 5 years post-treatment by superimposition of the radiographs on stable bone structures of the mandible and the anterior cranial base (Björk and Skieller, 1983). Three types of mandibular rotations were assessed: (1) Total rotation: change of a constructed implant line (IL) in the mandibular corpus relative to the anterior cranial base, (2) Matrix rotation: change of a tangential mandibular line (ML) relative to the anterior cranial base, (3) Intramatrix rotation: change of IL relative to ML.
RESULTS: Treatment changes: In both the high- and low-angle groups insignificant anterior total mandibular rotation occurred (0.1 and 0.3 degrees, respectively). Due to mandibular lower border remodelling (intramatrix rotation), matrix rotation was posteriorly directed (high-angle 0.4 degrees/ns; low-angle 0.5 degrees/$P < 0.05$). Post-treatment changes: In both the high- and low-angle groups significant

($0.05 > P > 0.01$) anterior total mandibular rotation was recorded (1.3 and 2.3 degrees, respectively). Due to mandibular lower border remodelling (intramatrix rotation which was opposite to that seen during treatment), matrix rotation was anteriorly directed and larger than total rotation (high-angle 1.9 degrees/$P < 0.05$; low-angle 2.4 degrees/$P < 0.001$). No statistical differences were found between the two examination groups.
CONCLUSION: During Herbst treatment almost no total mandibular rotation was observed. However, due to mandibular lower border remodelling, posterior matrix rotation occurred in both high- and low-angle subjects. On a long-term basis post-treatment, a significant anterior total and anterior matrix rotation of the mandible occurred in both high- and low-angle subjects. All components of rotation were larger in the low-angle subjects.

97 INITIAL APPEARANCE OF AN ODONTOCLAST INCIDENT TO TOOTH MOVEMENT

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AIM: To investigate histologically the initial stage of appearance of an odontoclast just before the start of root resorption during tooth movement, using tartrate resistant acid phosphatase (TRAP) staining.
MATERIALS AND METHODS: Three types of tooth movement model were adapted: 1) A compression area of periodontal membrane between the deciduous root and the crown of a permanent tooth, incident to tooth eruption in the mixed dentition of a rabbit; 2) A compression area of periodontal membrane of a rat molar, incident to experimental tooth movement by an orthodontic coil spring. Duration of the tooth movement was 1, 3 and 7 days respectively. 3) A compression area of periodontal membrane of root apical area, incident to depression of incisors of a monkey using orthodontic wires. Duration of the tooth movement was 1, 3 and 6 months, respectively. All specimens were fixed, embedded, sliced, stained with haematoxylin and eosin or TRAP, and observed light microscopically.
RESULTS: TRAP positive odontoclasts appeared on the deciduous root surface of the rabbit molar area incident to the permanent tooth eruption. There were thick layers of ameloblasts on the surface of permanent enamel at the opposite side. 2) TRAP positive mono- or multi-nuclear small odontoclasts were observed adjacent to resorbed cement on the root surface in the compression area of rat molar after 7 days' tooth movement. TRAP positive large odontoclasts were also observed on the dentine surface of the root resorption pit where no cementoblast could be seen. 3) TRAP positive mono- or multi-nuclear odontoclasts were observed on the root surface where no cementoblast was seen or the alignment of the cementoblasts was incomplete after 1 month of incisor depression in the monkeys. Very severe root resorption was observed on the apical root after 3 or 6 months of tooth movement. TRAP positive large odontoclasts were noticed on the root resorption area where no cementoblast was seen.
CONCLUSION: It is suggested, from this research, that the thickness of the cellular layer on the root surface has the most important role in protecting against attack by TRAP positive odontoclasts.

98 REDUCTION OF NASAL AIRWAY RESISTANCE AND NASALITY BY RAPID MAXILLARY EXPANSION

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AIM: Nasality is the existence of significant communication between the nasal cavity and the vocal tract. A high arched palate is one of the causes of open nasality. Treatment using rapid maxillary expansion (RME), results in a significant increase in the available airway space as well as reduction of nasal airway resistance. This study aimed to verify this.
SUBJECTS AND METHODS: Two groups of patients. RME was performed in Group 1 using a Hyrax appliance (9 patients). In Group 2, surgically-assisted, expansion was performed by opening the mid-palatal and pterygo-maxillary sutures to ensure bodily movement of both maxillary segments. The nasalance score was calculated using the nasometer.
RESULTS: Nasality showed a statistically significant decrease in both groups. Group 1 presented better results, which were attributed to the gradual procedure of expansion as well as the presence of a growth increment. In the surgically-assisted group expansion was carried out at a faster rate and was accompanied by inflammation and oedema of the tissues in addition to muscle fatigue.
CONCLUSION: Orthopaedic and surgically-assisted RME resulted in a decrease of nasality measurements with remarkable results in Group 1.

99 PERSONAL IDENTIFICATION USING CRANIAL RADIOGRAPHIC ANALYSIS

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AIM: To develop a new computer-aided method of individual identification by computerized analysis of the cranial structure.
MATERIALS: Thirty seven lateral radiographs of the skulls from patients under treatment at the Department of Otorhinolaryngology were analysed.
METHODS: Cranial radiographs were converted into digital images by a scanner process. The image of sella turcica was plotted and studied by specific software. The image was converted into 256 grey levels and 50 consecutive points of

sella turcica were identified by six different algorithms. The best algorithm was used to find the best spectral parameters related to the morphology of sella. The discriminant analysis was performed to identify the characteristics of sella turcica.
RESULTS: A good discriminant power was found and there was also good identification in monozygotic twins.
CONCLUSIONS: The results seem to be good. Research to find a better algorithm and consequently new software, to eliminate the errors due to head position in space, will improve the results.

100 FREQUENCY OF BOLTON TOOTH-SIZE DISCREPANCIES AMONG ITALIAN ORTHODONTIC PATIENTS

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AIM: To determine the percentage of orthodontic patients who present with an interarch tooth-size discrepancy.
MATERIAL: Two hundred sets of plaster cast models belonging to 115 girls and 85 boys in the permanent dentition.
METHODS: Digital callipers were used to measure mesiodistal crown size diameters to a hundredth of a millimetre for Bolton's analysis, and the overall and anterior ratios were calculated. The mean, median, range, standard deviation, standard error of the mean, coefficient of variation, skewness and kurtosis were calculated for both the overall and the anterior ratios.
RESULTS: The mesiodistal crown size dimension of permanent teeth were greater than those found in similar studies carried out in American populations. Boys showed higher values than girls. Standard deviation of anterior ratio was higher than standard deviation of overall ratio. The data sets were normally distributed. One hundred and fifty patients had an interarch tooth-size discrepancy. The overall and the anterior ratios increased in 70 per cent of subjects and reduced in 30 per cent.
CONCLUSIONS: The results show that 75 per cent of patients have a tooth-size discrepancy that is related to the crown size of the anterior teeth. However, the crown size of the posterior teeth seems to compensate for the shift. It would therefore seem prudent for clinicians to routinely include a tooth-size analysis in their initial case work-up.

101 PHYSIOGNOMIC PROFILE RECONSTRUCTION OF THE FACE BY TELERADIOGRAPHS

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AIM: To develop a new computer-aided method to reconstruct physiognomic profiles of the face by teleradiographs.
MATERIALS: Thirty five cranial teleradiographs were obtained from a group of patients under treatment at the Department of Orthodontics.
METHODS: Cranial radiographs were converted into digital images by a scanner process. They were plotted and studied by a specific software to evaluate nine cutaneous and nine osseous landmarks and to automatically calculate their respective distances and angles. The probable thickness of soft tissues of the profile was calculated by multivariate regression analysis of the data.
RESULTS: The initial hypothesis of a significant correlation between osseous structure and cutaneous thickness was assessed. The calculation of correlation coefficients of osseous and cutaneous landmarks allowed reconstruction of the probable profile of a person starting from the osseous features.
CONCLUSIONS: The results appear sound and demonstrate the ability to reconstruct the probable physiognomic profile. The statistical problems will be studied on a larger number of subjects.

102 CHARACTERIZATION OF NICKEL-TITANIUM COIL-SPRINGS

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AIM: Nickel-titanium coil-springs were tested in traction to determine delivered forces.
MATERIAL: Nickel-titanium coil-springs drawn at random from two batches of two different manufacturers, GAC and Ormco.
METHODS: 1. One coil-spring from each manufacturer was examined with Scanning Electron Microscopy (SEM) to determine its shape and composition, 2. Transformation temperatures of alloys making up the coil-springs were established by Differential Scanning Calorimetry (DSC), 3. Forces delivered by the same coil-springs in traction from 0 to 10 mm were measured at different oral temperatures: 3, –5 and –55ºC.
RESULTS: 1. From SEM, it appeared that the surface roughness was slightly different for each manufacturer. All springs consisted of approximately 50 per cent nickel and 50 per cent titanium. No copper was detected. 2. Transformation temperatures, as established by DSC, were identical for the different coil-springs drawn from the same batch of each company, different from one batch to the other of the same company, and different from coil-springs of one company to the other. 3. All coil-springs showed superelastic properties when elongated. As observed from DSC, the forces delivered varied from one batch of each manufacturer to the other and also from one manufacturer to the other. The forces varied: they increased and decreased proportionally to temperature.
CONCLUSION: Optimal clinical use of nickel-titanium coil-springs would greatly benefit from a better understanding of their properties at oral temperatures.

103 EFFECTS OF THE CONSISTENCY OF DIET ON THE MANDIBULAR MORPHOGENESIS

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AIM: To evaluate the relationship between mandibular morphogenesis and masticatory function.
MATERIAL: Thirty male Sprague-Dawley rats, 28 days of age, randomly divided into three groups, received different diets regarding consistency: liquid, normal (control group), and elastic.
METHODS: The experiment lasted 28 days, at the end of which lateral radiographs of the cranium, photographs were taken of the hemi-mandibles magnified four-fold (V = vertical dimension; S = sagittal dimension), and histologic analysis of the condyle, electrophoretic and immunohistochemical analysis of the digastric, the masseter, the pterygoid and the temporal muscle was carried out.
RESULTS: Photographic analysis of the hemi-mandible showed significantly ($P < 0.05$) higher growth of the mandibular ramus stimulated by the elastic diet (V_2 2.4 mm; V_3 2.4 mm; V_4 1.9 mm; V_5 4.1 mm). On the contrary, a statistically significant ($P < 0.05$) lengthening of the mandibular corpus occurred in the rats subjected to liquid diet (S_1 4.5 mm; S_2 2.7 mm; S_3 1.6 mm; S_4 2.6 mm). Measurements were taken on both the radiographic and photographic records. The variation coefficient showed that photographic analysis was more accurate than the radiographic. Electrophoretic analysis showed that the elastic diet seemed to induce a decrease in 2B fibres with an increase in 2A and/or 2X fibres in the digastric, superficial masseter and temporal muscles. Conversely, the liquid diet produced an increase in 2B fibres in the internal pterygoid and temporal muscles. Histological and immunohistochemical analyses showed the same qualitative results.
CONCLUSIONS: From these data it appears that an increase in the tonus of the protrusive muscles could be beneficial in mandibular hypoplasia and the tonus of the masticatory muscles in skeletal open bite subjects.

104 CEPHALOMETRIC EVALUATION OF POSTERIOR AIRWAY SPACE IN UNILATERAL CLEFT LIP AND PALATE PATIENTS

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AIM: Facial growth in unilateral cleft lip and palate (UCLP) patients is influenced by a number of factors, including intrinsic lack of tissue, iatrogenic and also functional factors. The purpose of this study was to evaluate Posterior Airway Space (PAS) posture in such subjects.
SUBJECTS: Thirty eight consecutively treated UCLP patients (25 males, mean age 5.2 years; 13 females, mean age 5.1 years), non-syndromic, born between 1988 and 1993, were analysed. The protocol consisted of pre-surgical orthopaedics from 0 to 4–6 months, lip and nose surgery together with soft palate closure around 4–6 months and hard palate closure and gingivo-alveolo-plasty at 18–36 months. All the operations were carried out by the same surgeon.
METHODS: The first cephalometric radiographs were taken at 5 years of age. PAS was evaluated with Ricketts' analysis. The results were statistically analysed and compared with the data proposed by Scholhof (1978) for non-cleft patients.
RESULTS: There was a reduction in PAS (AD_1-Pns –4; AD_2-Pns –4.6; Ptv-AD –0.4) (mean values: AD_1-Pns 14.6 ± 33; AD_2-Pns 10.8 ± 2.5; Ptv-AD 6.6 ± 3.4) in the UCLP sample.
CONCLUSION: Analysis of the results shows a substantial reduction in PAS. This alteration could mean potential aggravating factors for skeletal and occlusal anomalies in UCLP patients (reduced sagittal and transverse dimensions of the maxilla, and mandibular hyperplasia). A correct therapeutic approach requires the elimination of such dysfunctions along with a traditional orthopaedic and orthodontic therapeutic approach to obtain eugnathic maxillofacial growth.

105 MEAN ERUPTION TIMES OF THE PRIMARY AND PERMANENT TEETH

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AIM: To construct a chart which is practical for international clinical use by orthodontists, paedodontists, paediatricians, family dentists and doctors and researchers in forensic sciences, etc. The chart is based on the mean ages at emergence and onset of dental stages (DS) with standard deviations (DS with s.d.) of the permanent and primary teeth of Icelandic children.
SUBJECTS: The first group consisted of 1,641 randomly selected children (791 boys and 850 girls) at 5–17 years of age, corresponding to 9.5 per cent of the total secondary school population in Reykjavik in the school year 1972–3. The second group consisted of 927 pre-schoolchildren (498 boys and 429 girls), corresponding to 9 per cent of all children in the age range 0–83 months in Reykjavik in 1978–9, who attended for regular examinations in two health centres and also children in three kindergartens in Reykjavik.
METHODS: A tooth was recorded as having emerged if it was visible and, in cases of doubt, if it sounded when percussed with a special instrument. Extracted teeth were recorded as emerged. Mean values, standard deviations and standard errors were calculated by probit analysis. The calculations were based upon the relative frequency in 3-month age groups.

RESULTS: The mean ages at emergence of the primary and permanent teeth, along with the ages at commencement of DS 01, DS 02, DS 2, DS 3, DS 4 and DS M2 in Iceland are given in the chart. A comparison was undertaken of emergence ages of permanent teeth in Icelandic boys and girls with those of 15 different ethnic groups and with nine ethnic groups regarding primary teeth. On average, the present mean times of emergence of teeth in ethnic groups and sexes were fairly similar and therefore it can be assumed that these small differences do not have relevance in the clinic. Tables with comparison for boys will be shown.
CONCLUSION: A chart with eruption times of primary and permanent teeth will be shown which provides a good basis for international clinical use.

106 EFFECT OF CHANGING FORCE MAGNITUDE ON THE RATE OF ORTHODONTIC TOOTH MOVEMENT

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AIM: To analyse the effect of increasing orthodontic forces on the rate of tooth movement in beagle dogs.
MATERIAL: Eight young adult beagle dogs.
METHODS: Mandibular third and fourth premolars were extracted. After 3 months implants were placed in the extraction diastema. Three months later an orthodontic appliance was constructed on the implant exerting a reciprocal force on the second premolar and the first molar. Different forces (10 or 300 cN) were applied to the left and right sides. After 6 months, all forces were increased to 600 cN. Time-displacement curves were constructed and the influence of force magnitude on the rate of tooth movement was statistically analysed.
RESULTS: Reciprocal forces on (small) premolars and (large) molars resulted in a faster mean tooth movement of the premolars than the molars ($P < 0.05$).The differences in the mean rates of tooth movement of the premolars within the same dog (10 versus 300 cN) were not significant ($P = 0.41$). Within dog comparison of the movement rate for the molars showed a force effect ($P < 0.05$). Increasing the force from 10 or 300 cN to 600 cN increased the movement rate of the molars ($P < 0.05$). For the premolars the change from 10 to 600 cN increased the rate ($P < 0.05$), but the change from 300 to 600 cN did not ($P = 0.60$). It is surprising that in most individual dogs premolars moved at a far higher rate than molars, but in some other dogs premolars and molars moved at the same rate. Furthermore, some individual dogs showed no influence whatsoever to the change in force magnitude on movement rate.
CONCLUSION: The effect of orthodontic forces on tooth movement in beagle dogs shows large inter- and even intra-individual differences. The effect of changes in force magnitude is highly variable amongst individual dogs. These effects may be related to individual or local differences in bone morphology and/or bone physiology.

107 DETERMINANTS OF MANDIBULAR CROWDING IN THE EARLY PERMANENT DENTITION

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AIM: To determine the pattern of ectopia and eruption of tooth germs in the early mixed dentition and the association with mandibular crowding in the early permanent dentition.
MATERIAL: Panoramic films from 213 untreated children, randomly sampled at 9–10 years of age. Four years later mandibular crowding was determined among 150 of the children at same stage of dental development.
METHODS: Ectopia and eruption of the permanent dental germs was assessed in relation to underlying deciduous teeth. Crowding (>2 mm) was recorded using Björk's method or dental casts. Multivariate logistic regression analysis was used to determine the risk of crowding due to ectopia or maleruption expressed as odds ratio (OR) adjusted for gender and method of recording. A two-sided α-value = 0.05 was chosen to be significant.
RESULTS: Crowding was found in 44.6 per cent of children with no difference between boys and girls. Ectopia was seen in 48.4 per cent of children with mesially positioned germs, more often among girls ($P = 0.003$). Distally positioned germs were more frequent, 32.4 per cent, than mesially positioned, 16 per cent ($P = 0.001$). Maleruption was seen in 81.7 per cent of children with no difference in mesial and distal eruption, but a mesial eruption pattern was more common among boys ($P < 0.001$). The risk of crowding was increased, though not statistically significantly, when ectopic teeth had been present, OR = 1.4 (one ectopic tooth) and OR = 2.3 (two or more ectopic teeth), but not when malerupting teeth had been present.
CONCLUSIONS: The study results indicate that the presence of ectopic teeth may increase the likelihood of later crowding.

108 GEOMETRIC DIFFERENCES BETWEEN COMMERCIAL BRACKET SYSTEMS AND INDIVIDUAL IDEAL OCCLUSION

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AIM: *In vitro* investigation of occlusion after treatment simulation with two bracket systems and the recommended arch forms, achieved without additional wire bending.
MATERIAL: Two set-up models from each of 20 patients (age: 11.6–25.8 years).
METHODS: Proversion™ Torque-D4® Plus Bioprogressive® (Ricketts®/Gugino™) brackets with a 0.018 inch slot were bonded onto the first 20 models (Group A) and Andrews Prescription-Twin brackets with a 0.022 inch slot onto the second 20 models (Group B). Each model was

initially set up in ideal occlusion, the contact points were determined, and the tooth alignment was recorded using the Orthomate™ intraoral camera. The appropriate archwires (stainless steel; Penta-Morphic® 0.018 × 0.025 inch edgewise, and Tru-Arch® 0.016 × 0.022 inch ribbonwise) were inserted and treatment was simulated in a warm water bath. For comparison with the situation before treatment simulation, the contact points were determined again and a second camera image was taken.
RESULTS: The upper second molars were extruded during treatment simulation with Proversion™ Torque-D4® Plus Bioprogressive® (Ricketts®/Gugino™) brackets and caused a blockage of the occlusion. After their removal, 27 per cent of the contact points previously achieved in the ideal tooth alignment were realized with both systems. The tooth alignment deviated by an average of 0.8 mm and 8.7 degrees from ideal alignment.
CONCLUSION: Without additional wire bending, it is only possible to achieve inadequate occlusion using the bracket systems investigated. Due to the wide variation in the shape and size of individual human teeth, it is not possible to find any type of bracket prescription that would ensure satisfactory treatment without additional wire bending.

109 ULTRASOUND BONE MEASUREMENT IN ORTHODONTIC PATIENTS WITH OSTEOPENIC PATHOLOGIES

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AIM: To analyse the data collected in a longitudinal investigation of orthodontic patients with juvenile rheumatoid arthritis (JRA) evaluated using the densitometer.
SUBJECTS AND METHODS: Ultrasound bone measurements in 45 osteopenic (21 males, 24 females) and 40 healthy patients (16 males, 24 females) aged 6–13 years were evaluated using the Achilles densitometer. All the patients required orthodontic treatment. Measurements on the os calcis included speed of sound (SOS), broadband ultrasound attenuation (BUA) and a calculated stiffness index. Ultrasound measurements were correlated with bone mineral density (BMD) of the jaws.
RESULTS: In healthy children BUA was lower in females. There were no significant differences in males and females in SOS values. SOS and BUA values decreased with age in males while in females SOS decreased with age but not BUA. The stiffness index decreased with age in both sexes. Sex differences for BMD were not significant. SOS, BUA and especially stiffness measurements were significantly lower in osteopenic children than in healthy controls.
CONCLUSIONS: The need to diagnose osteopenic bone and the difficulty of doing so on a panoramic or cephalometric film, highlights the need for a diagnostic methodology such as ultrasound bone measurement by the densitometer. This instrument gives information about bone density and structure. With this data it is possible to select the osteopenic patients whose BMD values permitted them to undergo orthodontic treatment without supplemental therapy and those who needed dietary calcium, vitamin D, and control of the inflammation process before and during orthodontic therapy. Ultrasound bone measuring seems to be ideal for orthodontic subjects as it is non-invasive and radiation-free.

110 INFLUENCE OF A BITE JUMPING APPLIANCE TREATMENT ON FACIAL GROWTH DEPENDING ON THE VERTICAL PATTERN

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AIMS: Antero-posterior and vertical changes appear during functional orthopaedic treatment of Class II patients. The aim of the present investigation was to demonstrate different effects of the bite jumping appliance in skeletal deep and open bite patients.
MATERIALS AND METHOD: Lateral cephalograms of 28 Class II division 1 patients (mean age 11.0 ± 1.9 years) were examined. All were treated with a bite jumping appliance. They were divided into deep, physiological and open bite groups due to their initial ML-NL angle.
RESULT: Significantly reduced SNA and increased NL-NSL angles were found after treatment of patients with skeletal deep bite or a physiological ML-NL angle. In the physiological group a backward tipping of the upper and a forward tipping of the lower incisors was also measured. The reduction of the SNA angle was larger in the deep bite group than in the physiological group. On the other hand no significant changes occurred in the open bite group but an improvement of the occlusion was found in all patients. No antero-posterior or vertical changes of the mandible were found in these three groups. The ML-NL angle also showed no alteration.
CONCLUSION: The bite jumping appliance will not alter the position of the mandible. Especially in skeletal deep bite cases the appliance hinders forward growth and increases the inclination of the maxilla. Backward tipping of the upper incisors and forward tipping of the lower ones is a known side effect of this appliance but this will only occur in patients with a physiological ML-NL angle. Skeletal improvement cannot be achieved in open bite patients. In these subjects the changes seem to be more dentoalveolar.

111 TREATMENT OF SKELETAL ANTERIOR OPEN BITE WITH A MAD IV APPLIANCE

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AIM: To evaluate the effects of a MAD IV appliance on the treatment of skeletal anterior open bite in a sample of growing patients.

MATERIALS AND METHODS: Lateral cephalograms and hand-wrist radiographs taken at the beginning and end of the observation period and at the end of MAD IV application, of 16 patients who had an anterior open bite with a skeletal-dental Class I or II malocclusion. The patients were observed for approximately 9 months without any orthodontic or orthopaedic intervention, to define the direction of facial growth. At the end of the observation period, the patients who showed a vertical growth direction resulting in an increased open bite, were treated with a MAD IV appliance which they were instructed to wear for 18 hours a day. The mean treatment period was 7.5 months. Forty five parameters were evaluated. A paired *t*-test was used for statistical evaluation of differences occurring in and between the periods.
RESULTS: During the observation period, there was a mandibular backward and downward rotation resulting in an increase in lower facial height ($P < 0.001$) and open bite ($P < 0.01$). During the treatment period, the patients showed anterior mandibular rotation with a statistical decrease in lower facial height and open bite ($P < 0.001$).
CONCLUSION: In the treatment of skeletal open bite subjects with a MAD IV appliance, skeletal changes also play a role together with dental and dentoalveolar effects.

112 THE RELATIONSHIP BETWEEN THE TRUE HORIZONTAL PLANE AND CONVENTIONAL REFERENCE LINES

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AIM: To determine the most suitable reference line relative to the true horizontal plane (THL)
MATERIAL: Lateral cephalometric films taken in the natural head position from 38 adults.
METHODS: The material was divided into four cranial type groups. (1) dolichocephalic; (2) mesocephalic; (3) brachycephalic and (4) hyperbrachycephalic. By means of descriptive values the reliability interval of reference planes was examined. Discriminant analysis was used for description of each group together with ANOVA in order to investigate the differences in each four groups.
RESULTS: The reliability interval of angles between THL and conventional reference lines showed that the angle between THL and NBa was the most reliable measurement for all groups (68 per cent). Discriminant analysis showed appropriate values in groups 2, 3 and 4. The first group differed slightly from the others. No differences were observed with ANOVA in any group.
CONCLUSION: Among the other reference lines NBa was the most reliable.

113 A NEW FORM OF ORTHODONTIC TREATMENT TESTED ON IDENTICAL TWINS

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AIM: To compare long-term facial changes after both 'traditional' and 'orthotropic' treatment. 'Orthotropic' (growth guidance) is an entirely new form of orthodontic treatment, which aims to convert vertical growth to horizontal growth by changing oral posture. Space is first made for the tongue and the patient is then taught to keep their mouth closed. It is claimed that this will allow all 32 teeth to align themselves without the need for fixed appliances.
SUBJECTS: A consecutive unselected series of 12 identical twins aged between 8 and 19 years of age at the start of treatment, who were treated by either traditional or orthotropic methods. Some were untreated and served as controls. They were on average over 10 years out of retention (traditional 2–25 years; orthotropic 5–19 years). No fixed appliances were used for the orthotropic patients.
METHOD: The dental and cephalometric records were recorded. Crowding was assessed using Little's index. A panel of 10 judges compared the facial changes. An error study was undertaken.
RESULTS: 1. The only significant dental changes were a gain in maxillary width on average 4.48 mm ($P < 0.05$) and reduction in upper crowding ($P < 0.05$) for the orthotropic subjects but this is not surprising as their original malocclusions were more severe. 2. There were no significant differences in the reduction in overjet or lower arch crowding. 3. Extractions appeared to make little difference to the results but were associated with long-term re-crowding. 4. Stability: Of the four twins who received traditional treatment the three who were not permanently retained, suffered significant relapse within a few years. In contrast, the occlusion of all five of the twins treated by orthotropics remained stable an average of 10 years out of all retention. One of the normal controls developed a severe malocclusion. 5. Appearance: After treatment 83 per cent of the judges rated traditionally treated children as less attractive than before, while 86 per cent considered that those who received orthotropic treatment were more attractive than before. Fifty per cent of the controls were judged to have improved and 37 per cent to have become worse. There were too few cases to carry out a valid cephalometric analysis. However it was interesting to note that despite the obvious changes in facial appearance, superimposition of the radiographs did not show more than marginal contrasts in skeletal growth.
CONCLUSIONS: Guiding skeletal growth by correcting oral habits and posture from a young age may reduce unwanted side-effects.

114 MODELLING OF THE ORTHODONTIC BRACKET–CEMENT INTERFACE

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AIM: The determination of the mechanical bond at the adhesive/enamel interface.

METHOD: A numerical model was developed to determine the composite mechanical properties of the homogenized matrix of enamel and adhesive, which is formed during orthodontic bracket attachment. In this investigation the matrix was assumed to consist of a set of monotonically aligned elliptical cylinders, which correspond to tags of adhesive penetrating the etched pores of the enamel surface. Tests were performed to estimate the depth of penetration and the volume fraction of adhesive in the pores of the enamel surface.
RESULTS: A Young's modulus and Poisson's ratio of 47,000 MPa and 0.3 for enamel and 12,000 MPa and 0.21 for adhesive, respectively, was used to define the material matrix. Plots of change in adhesive volume fraction (VF) ranging from 2 to 20 per cent of the enamel volume were considered. The orthotropic material parameters E_1, E_2, E_3, G_{12}, G_{13}, G_{23} and ν_{12}, ν_{13}, ν_{23} corresponding to Young's modulus, shear modulus and Poisson's ratio, respectively, were calculated with the results being normalized to the enamel material properties. It was shown that E_2 varied from 0.95 at 2 per cent VF to 0.61 at 20 per cent VF. E_1 and E_3 produced similar reductions from 0.98 at 2 per cent VF to 0.84 at 20 per cent VF. G_{12} and G_{23} varied from 0.96 at 2 per cent VF to 0.66 at 20 per cent VF with G_{13} varying from 0.98 at 2 per cent VF to 0.84 at 20 per cent VF. Poisson's ratio was noted to be close to invariant across the range of adhesive VF.
CONCLUSION: Numerical modelling has been used to quantify the orthotropic mechanical properties of the matrix of enamel and adhesive formed during bracket attachment. A novel computer model of the etched enamel/adhesive interface is presented. The results allow a more clinically valid model of the bracket–cement interface to be determined. Such a model can be used in the development and testing of new bracket/adhesive systems.

115 MEASURING ORTHODONTIC TREATMENT NEED USING THE DENTAL AESTHETIC INDEX

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AIMS: To evaluate orthodontic treatment need using the Dental Aesthetic Index (DAI) which measures linear function of some occlusal traits.
SUBJECTS AND METHOD: With random stratified clustered sampling, 40 schools in Hamedan were selected and 730 boys and 507 girls were evaluated. Four dental students, using a millimetre ruler, completed the designed questionnaires. Inter-examiner reliability was tested and controlled in two phases. The final results were analysed by SPSS.
RESULTS AND DISCUSSION: The range of the DAI varied from 16 to 49. A Student's *t*-test, after being certain of variance equality in the groups, showed that the DAI was higher in girls than boys and in the lower than higher age group ($P < 0.001$). The level of handicapping malocclusion was determined as DAI > 36, and the frequency of persons in this range of malocclusion was higher in comparison with other similar studies (10 compared with 6–8 per cent).

116 A THREE-DIMENSIONAL INTEGRATION SYSTEM FOR COMPUTED SIMULATION OF ORTHOGNATHIC SURGERY

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AIM: To introduce a newly developed three-dimensional (3D) integration system for computed simulation of occlusal, facial and skeletal changes following orthognathic surgery, and its clinical application.
MATERIAL AND METHODS: The system is composed of three non-contact measuring units: a dental model analyser using laser scanning (Unisn 250R), a facial analyser using coded pattern projection (Ogis Range Finder RFX IV) and computed tomography (CT) (Siemens Somatom Plus S). To construct the common 3D co-ordinates, the face bow, having three ceramic balls used as the standard point, was set on the maxillary dental arch to obtain 3D information from each measuring unit. The integrated measured values of landmarks on a craniofacial phantom model by the three measuring units were compared with those of a contact 3D measuring system (Mitsutoyo MXF203). For the clinical application, computed simulation was performed on a patient with severe facial asymmetry before and after orthognathic surgery.
RESULTS: The measurement reliability for the distance was 0.13 ± 0.08 mm in the dental model analyser, 1.61 ± 0.81 mm in the facial analyser and 0.56 ± 0.25 mm in the CT. The 3D graphics of facial and skeletal changes of the patient following surgery could be simulated based on the occlusal change.
CONCLUSION: 3D information from the different measuring units could integrate with high accuracy and its clinical application was also confirmed.

117 A THREE-DIMENSIONAL STUDY OF THE NASOLABIAL SULCUS

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AIM: To study the shape of the nasolabial sulcus three-dimensionally.
SUBJECTS: Forty one males with normal occlusion and 25 males with a Class II malocclusion in the age range of 18–25 years.
METHODS: The line between the Al (Alare) point and the Ta (Tuberele angulioris) point was defined as the base line of the nasolabial sulcus. Metal markers were attached to these two points and cephalometric radiographs were taken. Measuring methods: (1) On the postero-anterior (PA) cephalogram, the *x*- and *y*-axes were determined. On the

lateral cephalogram, the *z*- and *y*-axes were determined. (2) The co-ordinates of *x*- (width), *y*- (height) and *z*- (depth) were determined for each point. (3) The baseline of the nasolabial sulcus was projected two-dimensionally on to the *x*-*y* (PA) and the *y*-*z* planes (lateral cephalogram), and both angle and baseline lengths were measured. These were also measured three-dimensionally.
RESULTS: Normal occlusion group: The two-dimensional (2D) line lengths and slant angles were 37.31 ± 3.37 mm and 25.75 ± 3.86 degrees for the *x*-*y* plane and 34.31 ± 3.52 mm and 10.74 ± 5.36 degrees for the *y*-*z* plane. The three-dimensional (3D) line lengths and slant angles became 37.98 ± 3.58 mm and 27.69 ± 4.30 degrees. Class II malocclusion group: The 2D line lengths and slant angles were 37.76 ± 2.60 mm and 25.14 ± 2.93 degrees for the *x*-*y* plane and 34.22 ± 12.28 mm and 12.49 ± 5.88 degrees for the *y*-*z* plane. The 3D line lengths and slant angles became 37.68 ± 2.91 mm and 27.90 ± 3.25 degrees.
CONCLUSIONS: (1) No significant differences were observed in the mean values between the two groups regarding the lengths and slant angles of the baseline of the nasolabial sulcus. (2) The slant angle on the PA cephalogram was approximately twice as large as that of the lateral radiograph in the two groups.

118 LATEX VERSUS LATEX-FREE INTRAORAL ELASTICS—MATERIAL PROPERTIES CONCERNING TENSILE STRENGTH AND ELASTICITY

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AIM: To determine differences in maximum elasticity and tensile strength as a component of the material characteristics of equally sized latex and latex-free intraoral elastics.
MATERIALS AND METHODS: Overall 120 intraoral latex and latex-free elastics were tested. Six groups were created, according to the different elastics sizes and material properties, each consisting of latex (n = 10) and latex-free (n = 10) elastics. The elastics fulfilled the following properties given by the manufacturer concerning size (inch) and tensile strength (oz.): 5/16″ (6.5 oz), 5/16″ (4.5 oz), 4/16″ (6.5 oz), 4/16″ (4.5 oz), 3/16″ (6.5 oz), 3/16″ (4.5 oz). The experimental design was constructed for the Instron universal measurement system. All measurements were performed on the Instron machine using two hooks to hold the elastics without any preload and to stretch the object (200 mm/min) to maximum length until breakage. Maximum tensile strength and length were measured for each elastic. Unpaired *t*-tests (SPSS 7.5.1) were performed to determine differences in maximum length and maximum tensile strength in each group.
RESULTS: Highly significant differences were found in groups 1 and 2 (size 5/16″ 6.5 and 4.5 oz) concerning maximum length ($P < 0.001$) and tensile strength ($P < 0.001$) between latex [107.1 mm (SD 1.9); 38.8 N (SD 3.0)] and latex-free elastics [158.3 mm (SD: 3.2); 43.3 N (SD 3.7)]. In all other test groups highly significant differences were found when comparing maximum length ($P < 0.001$). No statistically significant differences were found concerning the maximum tensile strength between latex and latex-free elastics in the groups 3, 4, 5 and 6.
CONCLUSION: The latex-free elastics showed higher elasticity in all groups. The developed maximum form of latex and latex-free elastics on maximum load showed a significant difference only in groups 1 and 2, with the largest inside diameter (5/16″).
CONCLUSION: Latex-free elastics show higher elasticity than latex elastics.

119 LONG-TERM EVALUATION OF ORTHODONTIC TREATMENT WITH THE MORPHOGENETIC ANALYSIS

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AIM: Evaluation of morphogenetic changes during orthodontic treatment.
SUBJECTS: Thirty four patients followed-up 20 years after treatment.
METHODS: Cephalometrics were performed using the morphogenetic analysis at baseline (T1), after Bionator treatment (T2), after fixed appliance therapy (T3) and 20 years after treatment (T4). The classification was based on growth rotation (posterior, neutral, anterior), sagittal relationship (mesial, neutral, distal) and the vertical state (open, normal and deep bite).
RESULTS: Twenty one per cent of the patients demonstrated a posterior rotation of the mandible during Bionator treatment. No change in growth rotation was observed in 71 per cent of the individuals from T1 to T4. The sagittal base relationship evolved into a more mesial position during Bionator therapy (T1–T2) in 29 per cent of the patients. These effects remained stable during the follow-up period (T3–T4) in almost all patients (91 per cent). From T1 to T4 47 per cent of the patients evolved into a more mesial position. A continuing deepening of the bite in the vertical dimension was consistent during all observation periods. Bionator therapy (38 per cent of patients), during fixed appliance phase (15 per cent of patients). Only 10 per cent of patients had an increase in the vertical dimension during the fixed appliance phase (T2–T3). During the follow-up period (T3–T4) 20 per cent of patients showed a deepening of the bite, whereas 12 per cent demonstrated an increase of the vertical dimension.
CONCLUSION: This long-term study indicates that Bionator treatment results in a sustained posterior rotation of the mandible and a sustained decrease of the distal sagittal base relationship. The effects on the vertical dimension continue after termination of treatment towards a deepening of the bite.

120 A LONGITUDINAL EVALUATION OF LOWER DENTAL ARCH CHANGES IN EARLY ADULTHOOD

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AIM: To evaluate lower arch changes that occur in early adulthood in untreated subjects with a molar and canine Class I relationship.
MATERIAL: Dental casts of 15 subjects. The mean age at the first evaluation (T1) was 20.1 years and at the second (T2) 31.2 years.
METHODS: Dental cast measurements were obtained of intercanine width, intermolar width, arch length, arch perimeter, 35–45 mesio-distal diameters, and Little's irregularity index.
RESULTS: There was a significant decrease of inter-canine width, arch length, and also in the 35–45 mesio-distal diameters. The irregularity index showed an increase in anterior dental crowding. Inter-molar width and arch perimeter did not change significantly from T1 to T2.
CONCLUSION: The changes observed in this study can be considered as inherent to dental arch development and should be taken into account when deciding the ideal time to remove retention in young adult patients after orthodontic treatment.

121 OCCLUSAL CHANGES IN RETENTION USING PRESSURE SENSITIVE SHEETS

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AIM: Long-term stability is a major goal of orthodontic treatment. With appropriate orthodontic therapy, most patients will exhibit a stable result many years after retention. However, there are few reports about the change of occlusion, especially in the relationship between occlusion and other related oral functions, during retention. The aim of this study was to evaluate the changes of occlusal force (OcFr) and occlusal contact area (OcAr) in patients during retention.
SUBJECTS AND METHODS: Fifty-six young female adult patients (12–42 years of age) with various types of malocclusion (Angle Class I, II and III) during retention which were divided into Cl. I, Cl. II, surgical Cl. III (S-Cl. III), non-surgical Cl. III (N-Cl. III) and normal occlusion groups as controls (n=19, 9, 14, 7, 7 respectively. OcFR and OcAr from each subject were taken at least twice at different times (T1 and T2) during the retention period and evaluated using the Occlusal Prescale®.
RESULTS: In all malocclusion groups, both the OcFR and OcAr were significantly lower than the normal group. However, an increase in OcFR and OcAr was noted for most subjects, showing a 1.2–1.5-fold increase on average with the progression of the retention period. A significant mean difference in OcFR and OcAr between T1 and T2 was observed in Cl. I and Cl. II groups, but not in S-Cl. III and N-Cl. III groups.
CONCLUSION: Class III patients seem to require a longer retention period to acquire a stable occlusion.

122 RADIOGRAPHIC OBSERVATION ON THE DEVELOPMENT OF THE HUMAN MANDIBULAR CONDYLE

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AIM: To examine bone mineral changes in human mandibular condyles of children during development.
MATERIAL: One hundred Indian dry skulls classified according to Hellman's dental age.
METHODS: In order to evaluate the bone mineral density of cortical and trabecular bone, frontal and lateral radiographic images were obtained of the mandibular condyles by attaching an aluminium step-wedge to the film to give a reference image. Optical bone mineral density was scanned at the construction place of the condylar neck by a microdensitometer.
CONCLUSION: Cortical and trabecular bone of the condylar neck showed different patterns of mineral density. Cortical bone resembled the Scamon's growth curve of general somatic growth with two incremental periods; initial (IA–IIA) and final (IVA–VA), with a middle period of small increases (IIC–IIIC). Bone matrix showed the highest increase period during the initial stages (IA–IIA), followed by a small increase period.

123 A MUCOSAL SUBSTITUTE CONTAINING CULTURED KERATINOCYTES

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AIM: Histologic evaluation of a cultured mucosal substitute for intraoral implantation.
MATERIAL: Palatal mucosa and skin from beagle dogs.
METHODS: Primary cultures of keratinocytes from the palatal mucosa of beagle dogs were prepared in keratinocyte medium and stored in liquid nitrogen. Dog skin was de-epidermized (DED) after incubation for 2 weeks in phosphate buffered saline. Subsequently, 2.10^5 keratinocytes were inoculated on each of eight pieces of DED and maintained submerged in culture medium for 3 days, after which two cultures were harvested. The medium level was then lowered to expose the keratinocytes to air for 4 days to 3 weeks. After 4 days and 2 and 3 weeks the remaining six cultures were harvested. All samples were prepared for histology and stained with haematoxylin/eosin. The following parameters

were determined; number of cell layers, morphology of keratinocytes and extent of keratinization.
RESULTS: No remaining dermal cells were observed in the DED. Epithelial cell clusters were found in the DED probably due to in-growth of keratinocytes in empty hair follicles. Only a few layers of keratinocytes were formed on top of the DED after 3 weeks. The upper layers of the epidermis were flattened and keratinization occurred.
CONCLUSION: Dog oral keratinocytes can be cultured on a piece of DED forming a keratinized stratified epithelium. However, to resemble normal oral epithelium more closely, the culture system has to be improved to generate more cell layers. In addition, the expression of cytokeratins and basal lamina markers in the substitute has to be compared with that of normal oral epithelium. Eventually, mucosal substitutes will be transplanted to experimental wounds on the palate of beagle dogs as a model for tissue repair after cleft palate surgery.

124 EVALUATION OF OROPHARYNGEAL SPACE IN SUBJECTS WITH CLASS I AND II MALOCCLUSIONS USING LATERAL CEPHALOMETRY

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AIM: The aetiologic role of pharyngeal space on developing respiratory problems and craniofacial deformities is always under debate. The purpose of this investigation was to determine whether there are any differences in oropharyngeal dimensions between skeletal Class I and II malocclusions.
SUBJECTS AND METHOD: Eighty patients with Class I malocclusions (40 subjects divided into two groups 9–13 years of age and 40, 18–30 years of age) were compared with 60 patients with a Class II malocclusion due to mandibular deficiency (30, 9–13 years of age and 30, 18–30 years of age) according to the age group and type of occlusion. None of the subjects had any respiratory problem, facial asymmetry, aberrant growth pattern, parafunctional habits, TMJ disorders, vestibulo cochlear visual and hearing disorders, hypertrophy of adenoids or tonsils, or previous orthodontic treatment or maxillofacial surgery.
RESULTS: 1. There were no differences in oropharyngeal dimensions, soft palate, hyoid bone and cervical vertebral column position between Class I and II in the normal respiratory pattern. 2. During growth, the oropharynx grew in a vertical dimension whereas its sagittal depth remained mostly stable, and the hyoid bone moved downward.
CONCLUSION: There were no differences in oropharyngeal dimensions between Class I and II subjects in the normal respiratory pattern.

125 DENTOSKELETAL CHANGES WITH FUNCTIONAL EVALUATION OF APPLIANCE THERAPY

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AIM: Extensive clinical experience with early treatment of Class II malocclusions has shown that favourable responses, although quite possible and even likely, are not always achieved. The aim of this investigation was to evaluate in which patient and at what age functional therapy would be efficient.
SUBJECTS AND METHOD: Forty seven patients in the mixed dentition with an overjet > 5 mm were assigned to either early treatment with functional appliances (n = 32) or to observation (n = 15). The mean age in the functional group was 10.1 years and in the control group 9.9 years. The treatment period was 14.1 months and in the control group observation was 12.8 months. During the treatment period, according to ANB changes, the patients were divided into 'unfavourable', 'none favourable', 'favourable' and 'highly favourable' groups.
RESULTS: 1. Approximately 70 per cent of children undergoing early treatment with a functional appliance experienced a favourable or highly favourable reduction in skeletal deficiency. 2. On average functional appliance therapy produced greater mandibular change, but there was a considerable variation in the effect with the functional appliance in each area. 3. When evaluating the success or failure in growth modification, it is important to understand the variability in growth experienced by untreated patients. 4. On average, the dental changes with functional appliance therapy were measured at 63 per cent and the skeletal changes at 37 per cent.
CONCLUSION: Between the magnitude of the treatment response, the severity of the initial skeletal problem and growth pattern, no linear relationship could be determined.

126 MANDIBULAR GROWTH STUDY AND HISTOCHEMICAL EVALUATION OF THE MASSETER MUSCLE IN RATS

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AIM: To verify the mandibular growth and the physiological changes in the superficial masseter muscle after treatment with postural propulsion of the mandible.
MATERIAL: Twenty five 28-day-old male Wistar rats, divided among control and experimental groups.
METHODS: An appliance, made of stainless steel orthodontic band material, was bonded to the lower incisors of the experimental animals in order to cause forward displacement of the mandible. The experimental animals wore the appliance 24 hours daily for 2, 4 and 10 weeks. Histochemical methods were used to identify alterations in muscle fibre content and morphology. Muscle fibre types were determined after performing histochemical reactions for oxidative enzymes, succinic dehydrogenase and nicotinamide adenine dinucleotide-tetrazolium reductase-reduced form, and glycogen. The mandibular length was evaluated comparing the initial and final radiographs.

RESULTS: Comparison of the control and experimental groups showed that: (1) mandibular length was greater in the experimental animals, indicating that postural propulsion of the mandible had the expected positive effect on mandibular growth; (2) histochemically, the superficial masseter muscle in the experimental groups exhibited a significantly higher percentage of type B fibres, and (3) the diameter of the three fibre types decreased in the experimental animals, after 4 weeks of treatment.
CONCLUSION: The protrusive appliance caused the superficial masseter muscle to become more active with respect to tonic (postural) activity. This change in the physiological muscle activity is important in a permanent postural modification after the treatment of the Class II malocclusions which results from a deficiency in mandibular growth.

127 THE PERIODONTIUM IN CHILDREN AGED 7–12 YEARS WITH OPEN BITE MALOCCLUSIONS

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AIM: To study the functional condition of the periodontium of the permanent teeth of subjects aged 7–12 years with an open bite malocclusion.
SUBJECTS AND METHODS: Sixty children with an open bite malocclusion were examined in the mixed dentition period. The size of the overbite was, on average, 3.0 mm without contacts in the anterior part of the upper and lower dentition. The examination was carried out using the apparatus 'Periotest' (Siemens) which determined the mobility of the teeth as a response to percussion on horizontal loading.
RESULTS: The condition of the periodontium in the permanent dentition in subjects with an open bite resulted in an average increase in tooth mobility of 18.6 per cent on horizontal percussion. Marked differences were observed in the mobility of teeth in the upper and lower arches. In the lower arch this was 124.5 per cent from normal while in the upper arch it was 112.7 per cent. This mobility was associated with a decrease in the endurance of the teeth to horizontal loading. It was also found that mobility of all premolars was approximately 10 per cent higher on average than that of anterior teeth and first permanent molars.
CONCLUSION: The decrease in endurance of the periodontium to horizontal loading is evidence of the change of functional loading to the teeth. The anatomical features of the lower arch result in essential differences in the Periotest indices. The differences between the degree of mobility of the premolars and the other teeth may be a result of higher loading during incomplete formation of the roots.

128 DENTAL JAW ABNORMALITIES IN CHILDREN LIVING IN RADIATION POLLUTED AREAS

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The prolonged monitoring of the health of children suffering from the influence of radiation in the framework of the Federal programme 'Children of Chernobyl' allowed investigation of all systems of the human body, particularly growing organism that were exposed to the influence of 'Chernobyl factor'. According to all available data the health of children has become considerably worse. This is confirmed by changes not only in the whole organism but also in the dentition.
AIM: To determine the increase in dental jaw abnormalities in children who were born and lived in radiation polluted areas following the explosion at Chernobyl nuclear power station in 1986.
SUBJECTS AND METHOD: Five hundred and forty four children living in radiation areas with different levels of soil polluted by caesium (Cs)-137. All children examined were born between 1980 and 1992 and were divided into two groups. Group 1 born before 1986 and group 2 after 1986. Three sites were investigated according to the amount of pollution in the soil. R1—from 0–5 Ku/km; R2—from 5–15 Ku/km, and R3—from 15–45 Ku/km. The clinical examination determined the presence of teeth and abnormalities of the dentition, occlusion and their combinations.
RESULTS: Examination of the children showed the following features. The condition of the dental jaw system corresponding with the age standard was determined as the level of polluted areas were increased. The most increasing anomalies were the combination of teeth and occlusal abnormalities. It prevailed over all pathologies and over all areas.
CONCLUSION: The year of birth and degree of polluted soil influence the condition of the dental system with the greatest abnormalities found in the occlusion in combination with the dentition.

129 MALOCCLUSION AND TEMPOROMANDIBULAR DISORDERS: CORRELATION HYPOTHESIS

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AIM: To research a correlation between the presence of a malocclusion and symptoms of temporomandibular (TMJ) disorders in a sample of school age subjects in the city of L'Aquila.
SUBJECTS AND METHOD: A stratified sample of 805 students attending an elementary school was selected between 8 and 11 years of age. For the research a group of

dentist operators were instructed and all the clinical data were collected on an examination record chart.
RESULTS: Clinical symptoms of TMJ disorders were found in 118 subjects: 65.8 per cent presented pain in this area, while 34.2 per cent did not; 43.1 per cent had pain during palpation; 53.16 per cent presented joint clicking, while 71.42 per cent had spring or roar and 26.58 per cent manifested rustling or crackling. The muscles most affected by pain were the lateral pterygoids and masseters. In Class I subjects 82.85 per cent showed TMJ disorders, compared with 92.3 per cent with Class II and 100 per cent with Class III malocclusions.
CONCLUSION: A statistically significant correlation between malocclusion and TMJ disorders was not substantiated.

130 A HISTOMORPHOMETRIC AND SCANNING ELECTRON MICROSCOPY STUDY OF HUMAN CONDYLAR CARTILAGE AND BONE TISSUE CHANGES IN RELATION TO AGE

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INTRODUCTION: It has been shown that manipulation of craniofacial bone growth in humans at adulthood can be carried out with the Herbst appliance and treatment effects ascertained as growth modifications: biomechanically elicited changes in matrix (fibrocartilage) rotation and intramatrix (bone) rotation of the mandible with modelling of bone to adapt to the new position (Paulsen, 1997; Paulsen *et al.,* 1995*)*. However, are there possibilities for a later adaptive growth?
AIM: To determine the possibility for adaptive growth in human condyles by quantifying the thickness of fibrocartilage and the constitution of cells with potential activity, the trabecular bone volume, and the structural parameter, marrow space star volume, in human autopsy condyles.
MATERIAL: The sample consisted of 40 autopsy condyles from 20 individuals, 18–31 years of age.
METHODS: Histomorphometry (trabecular bone and marrow space star volumes), scanning electron microscopy and cartilage histology were used to analyse the tissue.
RESULTS: Slight, but statistically significant reductions were found in the thickness of the condylar cartilage and in the trabecular volume of the underlying bone tissue. Furthermore, quantitative and qualitative investigations of the turnover activity in the fibrocartilage and the bone tissue, describing the activity of hypertrophic chondrocytes and the trabecular bone tissue showed condylar growth potential until 30 years of age. However, growth activity seemed to decline with age.
CONCLUSION: Quantitative and qualitative investigation of the turnover activity in the fibrocartilage and the bone tissue, describing activity of hypertrophic chondrocytes and the trabecular bone tissue, indicated condylar growth potential until 30 years of age.

Paulsen H U 1997 Morphological changes of the TMJ condyles of 100 patients treated with the Herbst appliance in the period of puberty to adulthood: A long-term radiographic study. European Journal of Orthodontics 19: 657–668

Paulsen H, Karle A, Bakke M, Herskind A 1995 CT-scanning and radiographic analysis of temporomandibular joints and cephalometric analysis in a case of Herbst treatment in late puberty. European Journal of Orthodontics 17: 165–175

131 AN INVESTIGATION OF DURATION OF SWALLOWING WITH M-MODE ULTRASONOGRAPHY

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AIM: Ultrasound study of tongue movement has become popular in recent years. The use of M-mode gives a time-amplitude diagram that allows improved measurement of tongue movement. Therefore, it was the purpose of this study to investigate the duration of swallowing with the M-mode ultrasound technique.
SUBJECTS AND METHODS: Fifty five subjects were included in this study. A non-invasive dental/orthodontic diagnostic technique, computer-aided-B+M-mode ultrasonography, was used in combination with the cushion scanning technique (Peng *et al*., 1996) to measure tongue movements during swallowing.
RESULTS: With the M-mode technique, tongue movement was imaged in real time. Even delicate muscle contractions of the tongue during swallowing could be imaged and calculated. The average duration of swallowing was found to be 2.43 seconds with a standard deviation of 0.62 seconds.
CONCLUSIONS: In comparison with previous investigations of swallowing with radiocinematography, electromagnetic articulography or electromyography, M-mode ultrasound provides a safer, easier and more accurate way for the study of swallowing.

Peng C-L, Jost-Brinkmann P-G, Miethke R-R 1996 The cushion scanning technique—a method of dynamic tongue ultrasonography and its comparison with the transducer-skin coupling scanning during swallowing. Academic Radiology 3: 239–244

132 MANDIBULAR DISTRACTION OSTEOGENESIS IN SHEEP. A BIOCHEMICAL ANALYSIS

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AIM: To analyse *in vivo* a selected set of biochemical tissue parameters after lengthening, and osteotomy without lengthening in sheep mandibles.

MATERIAL: Nine adult Texel sheep, eight used as experimental animals and one as a control.
METHODS: Biochemical analysis was performed following distraction in eight sheep mandibles, and in one sheep mandible with a non-distracted osteotomy. The distraction was initiated after a 5-day latency period. The distraction rate was 1 mm per day in one increment, during a 20-day period. The analysis was performed at 40 days post-operatively and involved the mineral content, collagen, osteocalcin, total amount of proteins, glycosaminoglycans and transforming growth factor-β1 (TGF-β1).
RESULTS: The results were compared with a control area in the ramus and with a non-lengthened osteotomy model. The mineral concentration was lower in the lengthened zone than in the control bone. The collagen amount assessed as hydroxyproline, and the total amount of proteins showed slightly higher values than the control bone. The osteocalcin in the lengthened area was significantly lower and the concentration of TGF-β1 was significantly increased compared with the control area. The glycosaminoglycan concentration was decreased in the lengthened area, but this difference was not significant.
CONCLUSIONS: Mechanical forces in distraction osteogenesis principally stimulate the production of not fully calcified matrix after 6 weeks in association with a high TGF-β1 content, showing that TGF-β1 is involved early in bone matrix formation during stress. The results are in agreement with previous studies in dogs and both may be useful to develop a model of bone formation and calcification during bone lengthening procedures.

133 TENSOR ANALYSIS IN THE TREATMENT PLANNING OF PATIENTS WITH HEMIFACIAL MICROSOMIA

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AIM: To show the possibilities of using tensor analysis in treatment planing of patients with hemifacial microsomia (HFM).
MATERIAL: One hundred and fourteen cephalograms in lateral and postero-anterior (PA) projection of 25 patients were examined. The age of the subjects ranged from 6 to 20 years.
METHOD: In order to describe malformed regions of the facial skeleton, the following landmarks were selected and traced: Ar, Go, Me, S, ANS, Pr, Id, LO. These landmarks were related to *x-y* co-ordinates on lateral projection and *x-z* on the PA cephalograms. Two pairs of cephalometric tracings of the same patient were obtained. One was the deformed facial skeleton of the patient, and the other a mathematical reconstruction of the facial skeleton by Sassouni. The above points formed the triangles of the deformed and optimized tracing. They were analysed with the two-dimensional (2D) tensor method.
RESULTS: All tensors showed relative changes of shape and dimensions of analysed regions. The most significant deformation of size on the PA cephalograms was in the following triangles: Nc/Go/Me (malformed side) should be increased by 1.6; Nc/Go/Ar (malformed side) should be increased by 3.9; Ar/Go/Me (malformed side) should be increased by 2.1 on lateral cephalograms and Me/Go/Ar (malformed side) should be increased by 2.4.
CONCLUSIONS: 2D cephalometric analysis is a popular and cost-effective method. It provides some information on existing deformation of the skeleton. Because of severe skeletal malformations in HFM patients more sophisticated three-dimensional methods are necessary, including computed tomographic images.

134 THREE-DIMENSIONAL TENSOR ANALYSIS OF SKELETAL DEFORMITIES IN TEMPOROMANDIBULAR JOINT ANKYLOSIS

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AIM: To determine changes of the facial skeleton in patients with temporomandibular (TMJ) ankylosis in space and time.
MATERIAL: One hundred cephalograms in lateral (LL) and postero-anterior (PA) projections from 17 patients with TMJ ankylosis. The mean time between the first and the last cephalogram ranged from 2 to 4 years. The subjects were 10 girls and 7 boys aged 2–20 years, mean 10.6 years.
METHOD: The software for acquisition of the images and for the three-dimensional (3D) tensor analysis was written in ITACS. The 3D tensor analysis described changes of the facial skeleton (compressions, extensions, and their directions), on co-ordinated cephalograms in LL and PA projections. In each facial region four anatomical landmarks were selected, and a tetrahedron was constructed in a co-ordinate system. The ankylosed side was marked 'a'. A sphere was inscribed into the tetrahedron on the first cephalogram. If there was dilatation between first and last cephalogram, the sphere transforms into an ellipsoid with three axes a, b and c.
RESULTS: Two regions in a typical child with TMJ ankylosis will be presented. In the region of the tetrahedron Or-Or′a-Me-Go′, which represents the corpus of the mandible on the ankylosed side, a severe compression was evident: axis c = 0.86, angle 1 = 66 degrees, angle 2 = 73 degrees. In the region S-Ar′a-Go-Go′a, which represents the ramus of the mandible, the following dilatations were found: maximum extension along axis c = 1.53, angle 1 = 7 degrees, angle 2 = –71 degrees. The middle extension axis a = 1.08, angle 1 = –81 degrees, angle 2 = 0 degrees. The least extension axis b =1.04, angle 1 = 8 degrees, angle 2 = 18 degrees.
CONCLUSION: 3D tensor analysis showed different degrees of skeletal deformation along the axes of dilatation related to the co-ordinate system.

135 INFLUENCE OF ACTIVATORS AND BITE JUMPING APPLIANCES ON OVERBITE

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AIMS: Regarding the influence of functional orthopaedic treatment on Class II patients, vertical changes of the dentition and facial growth occur as well as the antero-posterior correction. This study was performed to evaluate changes of the overbite depending on the initial overbite and ML-NL angle during treatment with activator or bite jumping appliance.
MATERIAL AND METHOD: Casts and lateral cephalograms of 67 Class II division 1 patients were examined. Thirty nine were treated with an activator (mean age 9.6 ± 1.3 years), and 28 with a bite jumping appliance (mean age 11.0 ± 1.9 years). They were divided into an open bite, physiological overbite and deep bite group according to their initial overbite. Additionally they were split into a skeletal open and skeletal deep bite group.
RESULTS: The overbite was significantly reduced in deep bite patients ($P < 0.01$). In those subjects no difference was found between the effect of both appliances. The values also decreased in patients with physiological overbite who were treated with an activator ($P < 0.01$), but there was no change in those treated with the bite jumping appliance. The overbite significantly increased in open bite patients ($P < 0.05$). A significant reduction of the overbite was found in skeletal deep bite patients treated with an activator ($P < 0.01$), whereas no change occurred in the bite jumping appliance group. There was no alteration in the skeletal open bite patients with either appliance.
CONCLUSION: Both appliances reduce the overbite in deep bite subjects and increase it in those with an open bite. Especially in deep bite patients with skeletal deep bite, the activator is more effective. Treatment with the bite jumping appliance will not result in an increased overbite as a side-effect of the inevitable tipping retraction of the upper incisors.

136 INCIDENCE OF DENTOALVEOLAR ANOMALIES AT SEVEN YEARS OF AGE

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AIM: To determine the incidence of dentoalveolar anomalies.
SUBJECTS: Eight hundred and fifty children, 7 years of age, attending several schools of Cluj-Napoca.
METHODS: All children were systematically examined to ensure that the evaluation was complete. The presence of dentoalveolar abnormalities as well their association with several dysfunctions such as oral-breathing, inferior lip sucking and atypical swallowing was followed. Problems regarding the first permanent molar were also closely studied.
RESULTS: Dentoalveolar abnormalities were found in 56.9 per cent of the examined children and 52.2 per cent had dysfunctions and practised vicious habits. Among the dentoalveolar abnormalities, deep bite was most frequent at 17.2 per cent, constriction of the maxillary arch 11.7 per cent, progenia 10.6 per cent, open bite 4.2 per cent and mandibular retrusion 2.1 per cent. The most frequent dysfunction was oral-breathing 34.37 per cent, followed by atypical swallowing 14.28 per cent and inferior lip sucking 10.21 per cent. In many subjects these dysfunctions were associated: 22.45 per cent of the oral-breathing children had atypical swallowing and 18.36 per cent of the oral breathing children sucked their inferior lip. In 88.2 per cent of the subjects at least one of the first molars was affected by decay.
CONCLUSIONS: These results show the importance of prevention and interceptive therapy at this age when solving dysfunctions leads to improvement of dentoalveolar anomalies and creates good conditions for harmonious development of dentoalveolar system

137 CHANGES IN THE CONVEXITY OF THE FACE IN SUBJECTS WITH MANDIBULAR PROGNATHISM

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AIM: In subjects with mandibular prognathism, apart from elongation of the mandible and a prominent chin, one often perceives the retraction of the middle area of the face that additionally distorts its appearance. The aim of this study was the cognition of the pathomechanism of this change in morphology of the facial part of the skull in subjects with mandibular prognathism.
SUBJECTS: Thirty two patients with mandibular prognathism, aged from 15 to 20 years, in whom the cephalometric measurements enabling cognition of the position and the magnitude of the maxilla in the sagittal diameter were made. These were as follows: 1. The SNA angle determining the position of the maxilla; 2. Measurement of the convexity of the maxilla at point A according to Ricketts measured in millimetres between NPog and APog. Measurement of the length of the maxillary corpus with reference to NS was undertaken according to the method of Schwarz.
RESULTS: In 11 subjects with mandibular prognathism a decrease of the angle SNA from 3 to 12 degrees was found indicating maxillary retrusion. In these patients a reduction occurred in the convexity of the maxilla at point A, which was confirmed by the negative results of the distance NPog and APog from –2 to –12 mm The length of the maxillary corpus varied between 2 and 10.5 mm.
CONCLUSION: Reduction of the convexity of the face in subjects with mandibular prognathism is a consequence of the inhibition of sagittal growth of the maxillary base.

138 SOFT TISSUE PROFILE AND MOLAR POSITION IN CLASS II NON-EXTRACTION TREATMENT

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AIM: To evaluate the soft tissue and molar position changes in non-extraction treatment of subjects with Class II

malocclusions performed by means of full edgewise appliances and headgear.
SUBJECTS AND METHODS: Forty five patients, aged from 9 to 12.5 years, showing a Class II malocclusion and moderate space deficiency in the mandibular arch. Non-extraction treatment was planned: Thirty patients wore cervical headgear and 15 high pull. The mean treatment time was 2.3 ± 0.3 years. Lateral cephalograms were taken before and after treatment. The following variables were measured: nasolabial angle, EL-UL and EL-LL (distance between the aesthetic line and the upper and lower lip respectively), soft ANB, soft ANPg and H angle. The position of the upper first molar was evaluated according to Byloff (1997) with respect to the sagittal and vertical position and inclination. In order to assess changes in both groups a Student's *t*-test was performed.
RESULTS: Significant changes were found in the cervical headgear group for EL-UL, EL-LL, soft ANB, soft ANPg and H angle ($P < 0.001$) and with respect to MY (distance between molar crown and palatal plane NL) and MX (distance between molar crown and perpendicular plane to NL passing through Pt) ($P < 0.01$). A significant variation was found only with MX variable in the high pull group ($P < 0.05$).
CONCLUSION: The results suggest that cervical headgear is effective in straightening the soft tissue profile and moving the upper first molars distally in the treatment of Class II malocclusion, whereas no significant changes were observed in the soft tissue profile and molar sagittal position with high pull extra-oral forces.

139 FINITE ELEMENT ANALYSIS OF STRESS IN THE PERIODONTAL TISSUES BY ORTHODONTIC FORCES

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AIM: To investigate the stress levels induced in the periodontal tissues by orthodontic forces using the three-dimensional (3D) finite element (FE) method.
MATERIAL AND METHOD: The 3D FE model of an upper canine was constructed on the basis of 60 digitized transverse sections. A force of 1N was applied in a labiolingual direction at the midpoint of the crown. The initial stress was calculated for no bone loss, and then successive computations were performed after reducing the height of the alveolar bone by 2, 4, 6 and 8 mm. 3D colour images, showing the intensity of tensions and areas of extension, were generated. The distribution of compressive, tensile and shear stress and Von Mises tensions were calculated.
RESULTS: A progressive increase of the stress in the labial and lingual zones of the periodontal tissue was observed when the length of the alveolar bone was reduced.

140 ADVANTAGES OF USING ARCHITECTURAL ANALYSIS IN DIAGNOSING OBSTRUCTIVE SLEEP APNOEA

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AIM: Several cephalometric studies have been carried out into obstructive sleep apnoea (OSA). The aim of this research was to examine the advantages of architectural and structural analysis including both the cranium and the face.
SUBJECTS AND METHOD: One hundred and sixty patients diagnosed with OSA by polysomnography. Lateral radiographs were taken and compared with those of 80 control subjects. Computed architectural and structural analysis and Down's analysis were both used. The findings were then computed by univariate and multivariate analysis.
RESULTS: The apnoeic patients presented a more obtuse anterior angle of cranial base and higher cranial height. Therefore, the craniofacial tendency can be defined as orthofrontal or transfrontal. In the sagittal plane, a retroposition of the maxilla relative to the cranial base and a large skeletal antero-posterior discrepancy, principally caused by smaller mandibular corpus, were observed. Other mandibular measurements were also abnormal. In the vertical plane, a large gonial angle, a shorter ramus, excessive incisor-chin height and high lower facial height were confirmed by both a steep mandibular plane and a vertical growth axis. A displacement of the hyoid bone to a lower position and a smaller posterior airway space were also significantly different from the control subjects; the length of the soft palate and the posterior angle of the cranial base, however, were not. The linear function permitted correct classification of 87 per cent of patients.
CONCLUSIONS: The advantages of architectural analysis are numerous. The analysis is personalized, using the cranial base of the individual subject, with a few standardized measurements; it can be used on edentulous patients; it successfully classifies patients; the technology is easy to use and inexpensive and the computed analysis can easily be communicated to other clinicians; moreover, with the patient's anamnesis and the polysomnography, the architectural analysis provides an aetiologic diagnosis, and can guide therapeutic choices. This type of analysis is indispensable prior to any surgical treatment and any oral appliance. Thus, a generalized use of this method represents an important contribution to the understanding of OSA.

141 CRANIOFACIAL MORPHOLOGY IN SUBJECTS WITH OBSTRUCTIVE SLEEP APNOEA

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AIM: To understand the utility of cephalometry in diagnosis and treatment of obstructive sleep apnoea (OSA). Two steps were used: first, to understand the craniofacial morphology

of apnoeic patients, and then, to prove effectiveness of a mandibular propelled appliance.
MATERIAL AND METHOD: Lateral cephalometric radiographs of 180 adult patients, with OSA diagnosed by polysomnography, were compared with 80 control subjects, matched according to age. A 'cephalometric architectural analysis' was used in addition to traditional cephalometric landmarks. Sixty five observations were analysed with univariate and multivariate statistical analysis. A propelled inferior maxillary appliance the Propulseur Pistes Posterieur (PPP), was then used in 10 patients with a weak RDI and control polysomnography.
RESULTS: The cranial base was different in the OSA subjects but, in the sagittal plane, a retroposition of the maxilla relative to the cranial base and a large skeletal antero-posterior discrepancy, principally caused by a smaller mandibular corpus, were observed. However, other mandibular measurements were also abnormal, and an increased lower facial height was noted. The sleep quality index was increased significantly and the apnoea/hypopnoea index was reduced (<5/h). The sleep efficiency index remained normal (>90) whilst the sleep continuity index was improved. The snoring disappeared. The hypnograms pre- and post-treatment were different.
CONCLUSION: Cephalometric analysis of bone tissue can sometimes explain OSA and completes the polysomnography. Its use enables discernment of the aetiopathology following which treatment aimed at mandibular propulsion is recommended.

142 AN EVALUATION OF WITS' ANALYSIS IN AN IRANIAN POPULATION AGED 9–15 YEARS WITH A CLASS I SKELETAL PATTERN

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AIMS: To determine the mean value of Wits' measurement in a specified age group, to search for any differences in this measurement in age groups 9–11 and 12–15 years and to compare Wits' values with ANB angle in subjects with mandibular rotation.
MATERIAL AND METHODS: One hundred and seven lateral cephalometric radiographs of 9–15-year-old patients with a skeletal Class I relationship according to clinical observation and Wylie's analysis were studied. Fifteen cephalometric landmarks as well as reference planes were used: SN, NA, NB, Go-Me, FH, and traditional occlusal plane. All the cephalograms were traced twice and the measurements of SNA, SNB, ANB and mandibular plane angles together with the measurements of Wits' and Wylie's analyses were obtained. The samples were divided into two age groups (9–11 and 12–15 years).
RESULTS: The mean values of Wits' measurement were –1.55 mm for males and –1.28 mm for females. There were no gender differences. The Wits' mean for the first age group was –1.38 mm and for the second age group –1.45 mm. There were no significant intra-group differences, indicating the probable constancy of this value in different ages. The Wits' mean value in samples without jaw rotation according to mandibular plane angle was –1.56 mm, and for the mandibular plane values outside 27 and 37 degrees –1.22 mm. The difference between the two values was not significant. The mean value for ANB angle in subjects without jaw rotation was 2.48 mm and in those with jaw rotation 4.80 mm. The difference between the two values was significant. The Wits' mean value obtained in this study and Jacobson's value showed significant differences, being greater in this investigation.
CONCLUSION: Wits' measurement was found to be greater than the value presented by Jacobson i.e. (–1:00). However, further studies are required. In assessing sagittal jaw relationships, Wits' analysis is more reliable than ANB angle and may be a better alternative.

143 FRICTIONAL FORCES OF SELF-LIGATING AND CONVENTIONAL BRACKETS

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AIM: To investigate the frictional forces generated by a self-ligating bracket compared with two conventional brackets and to evaluate the influence of wire material, size, and bracket angulation.
MATERIAL: A self-ligating bracket (Ormco Twin-Lock), two conventional brackets (Ormco Ormesh MiniTwin, Ormco 'A' Company Roth MiniTwin), and two wires (stainless steel, TMA) in two dimensions (0.018 inch and 0.017×0.025 inch).
METHODS: A Tensometer 10 testing machine was used to measure the force needed to overcome friction and make the bracket slide along the tested wires, either parallel or at an angle to the wire (0, 3, 7, 12 degrees). Basic friction of the testing device was measured and subtracted from the results. The self-ligating bracket was tested in the closed position, while a normal force of 2 N from 0.010 inch steel ligature wire was applied on the wire in the case of conventional brackets. Wire tension was kept at 3 N by means of a calibrated spring. Tests were made at room temperature and in the dry state.
RESULTS: Beta titanium wires had a markedly higher friction than stainless steel, and for all bracket/wire combinations friction increased with angulation, as binding between bracket and wire occurred. The self-ligating bracket exhibited lower friction compared with conventional brackets due to the lack of normal force from ligation even at higher angulations.
CONCLUSION: Self-ligating construction is seen to improve the frictional characteristics of brackets by reducing the normal force due to conventional ligatures. However, the self-ligating bracket also shows binding to the wire at increasing bracket/wire angulation. Therefore, angulation should be minimized, even when choosing brackets for sliding mechanics.

144 SUBMENTO-VERTEX RADIOGRAPHY DETERMINES THE TYPE AND AMOUNT OF RAPID MAXILLARY EXPANSION

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AIM: To determine the reliability of the submento-vertex radiograph in orthopaedic and surgically-assisted expansion cases.
MATERIAL AND METHODS: Submento-vertex radiographs of 15 patients between 14 and 25 years of age undergoing rapid maxillary expansion (RME) with a Hyrax appliance (9 patients with an orthopaedic technique and 6 patients with surgically-assisted RME).
RESULTS: In all radiographs studied, the submento-vertex view proved to be standardized, the trans-spinosum axes proved to be an accurate measurement for the exact opening of the mid-palatal suture since it depends on fixed bony structures. In addition, the perpendicular from the midline to the trans-spinosum axis can provide information about any rotation in the maxillary arch, as well as the amount of expansion on each side. This view proved its reliability in borderline cases: a girl of 15.5 years of age had the pterygo-maxillary suture non-ossified and orthopaedic expansion proved to be successful.
CONCLUSION: The submento-vertex radiograph could be a more precise diagnostic tool rather than age in determining the appropriate RME technique.

145 CRANIOFACIAL CHARACTERISTICS OF PATIENTS WITH PIERRE ROBIN SYNDROME AND THOSE WITH ISOLATED CLEFT PALATE

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INTRODUCTION: Pierre Robin Syndrome (PRS) is a congenital abnormality characterized by (1) micro- and retro-gnathia, (2) glossoptosis and (3) frequently a cleft palate.
AIM: To define the craniofacial characteristics of adult patients with PRS and those with an isolated cleft palate. These results were compared with those obtained from a control group without malformations.
MATERIAL AND METHOD: An examination of lateral cephalograms of 10 patients with PRS including cleft palate, mean age 21.2 years, 13 patients with isolated cleft palate, mean age 22.4 years, and a control group consisting of 17 persons, mean age 22.5 years, was carried out. Cephalometric measurements were based on the Hasund analysis. In addition, skeletal measurements of angles and especially of distances and 13 soft tissue measurements were undertaken.
RESULTS: Statistical differences were found between the patients with PRS and the control group as well as between the cleft palate patients and the control group. There was a significant decrease in values for the length and sagittal position of the maxilla and the mandible and also for the length of the anterior cranial base in both cleft groups. A significant increase in the inclination of the mandible to the anterior cranial base was observed. The soft tissue measurements showed a significant difference only for the chin-throat-angle, which was larger in patients with PRS than in those without a cleft palate.
CONCLUSIONS: There must have been previous catch-up mandibular growth among the children with PRS resulting in craniofacial development similar to the patients with isolated cleft palate.

146 BONE INDUCTION USING BIODEGRADABLE MATRICES FOR THE HEALING OF EXPERIMENTAL CRANIAL DEFECTS IN DOGS

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AIM: Evaluation of bony defect repair by calcium-phosphate bone cements and three combinations of demineralized bone powder (DBP) with polymers.
MATERIALS AND METHODS: Two mongrel dogs were used in a pilot study. In each skull four defects were made with a critical size diameter of 12 mm (not self-healing). One dog was used for the polymer study, the other for the Ca-phosphate study. The implants used in dog 1 were three different copolymers (poly-lactide and caprolacton) in combination with DBP and a control defect with autogenous bone. The defects in dog 2 were filled either with autogenous bone as a control or with Ca-phosphate bone cements D, H and F.

Qualitative and quantitative evaluation was carried out by means of different techniques: ^{99}TC NMP measurements, light microscopy, fluorescent microscopy, CT-scan and radiography. The chemical composition of the cement after setting was characterized by X-ray diffraction and infra-red spectroscopy. The dogs were sacrificed after 28 weeks.
RESULTS: Dog 1: All the polymer defects were filled with active fibrous tissue with centres of bone trabeculae. There was marginal osteoinduction only in copolymer 2. Dog 2: Only cement H showed zones with bone formation and remnants of blood: fibrinogen and bone trabeculae were detectable.
CONCLUSION: From the tested materials, cement H and copolymer 2 + DBP were found to be a possible alternative for autogenous bone grafting, but further investigation is necessary.

147 ASSESSMENT OF CORROSION AND CYTOTOXIC BEHAVIOUR OF NEW ORTHODONTIC NiTi-ALLOYS

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AIM: Two new NiTi alloys, NbNiTi and CuNiTi, have recently been introduced in orthodontics. The aim of this

study was to assess the corrosion and the cytotoxic behaviour of these archwires.
MATERIAL AND METHODS: The archwires CuNiTi (CopperNiTi™, Ormco Corp., USA) and TiNb (Titanium Niobium/FA™, Ormco Corp., USA) were investigated. A NiTi wire (Nitinol™, Unitek Corp., USA) and a copper wire were included as a negative and a positive control, respectively. The corrosion properties were tested by a static immersion test according to ISO standard 1562:1993(E) Annex A. Mosmann's MTT-Test [MTT = 3(4.5 dimethyithiazol-2-yl)-diphenyl-tetrazolium bromide] on L-929 mouse fibroblasts was performed according to ISO-standard 10993–5 to assess the cytotoxic behaviour. The corrosion released trace elements in the suspension and the eluates were qualitatively and quantitatively analysed by plasma atomic emission spectrometry. The test was performed twice for each wire.
RESULTS: In the first 4 days NiTi and TiNb alloys showed almost the same corrosion behaviour in the static immersion test. On days 5–7 the release of Ti and Ni was lower for the NbTi than for the NiTi wire. The CuNiTi wire had a continuous release of Cu. On days 5–7 the amount of Ni and Ti in the suspensions was approximately twice as high as in the negative control. In the MTT-test the NiTi wire and the TiNb-alloy did not influence cell proliferation. The CuNiTi wire reduced the cell-proliferation between 9.4 and 10.8 per cent. These results correlated with the amount of copper in the eluates (0.12 and 0.2 ppm).
CONCLUSION: The analysed new titanium alloys fulfil the ISO standards and can be assessed as corrosion resistant and non-cytotoxic. The NbTi is slightly more resistant than the NiTi alloy. The addition of copper decreased the excellent corrosion and cytotoxic behaviour of the NiTi alloy.

148 *IN VIVO* INVESTIGATION OF BONE QUALITY TO EVALUATE MANDIBULAR BONE MATURATION

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AIM: To investigate different parameters of bone quality to evaluate structural bone maturation of the growing mandible.
MATERIAL: Mandibles of pigs were taken from the slaughter-house and prepared immediately after the animals had been killed. The pigs were selected according to age, and the total sample subdivided into three groups (A = young, B = young adult, C = adult). Ten mandibles were studied in each group.
METHODS: The architectural organization of the mandible was measured by ultrasound transmission velocity (UTV) at a frequency of 2 MHz; bone mineral density (BMD) was determined by qualitative computer tomography, and hardness of Vickers (HV) was measured at the cortical surface at three different regions (anterior basal, posterior basal, ascending ramus) of fresh specimens. The data and the group differences respectively were statistically analysed (ANCOVA-test).
RESULTS: There was an increase in UTV from young pigs (mean: 1,942 ± 226 m/s) to young adults (2,226 ± 257 m/s) and a decrease in the adult groups (1,924 ± 340 m/s) in all three regions. The BMD increased from group A (868 ± 296) to group B (1,134 ± 295) but showed only small changes in group C (1,062 ± 323). A continuous decrease in the cortical hardness given by Vickers (mean: A: 5,142 ± 828 V, B: 4,838 ± 1,319 V, C: 4,103 ± 998 V) was found.
CONCLUSION: The results confirm that bone tissue modification during growth can be monitored with the methods used. The age-related changes in the parameters: architectural organization, bone mineral density, and HV in the analysed animals were uncorrelated. The results demonstrate differences in the type and kinetic of bone maturation at the mandible.

149 INFLUENCE OF TRANSCUTANEOUS ELECTRICAL NERVE STIMULATION ON THE POWER SPECTRUM OF ELECTROMYOGRAPHIC SIGNALS

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AIM: To analyse electromyographically the effect of 20 minutes of transcutaneous electrical nerve stimulation (TENS) on the anterior temporal and superficial masseter muscles.
SUBJECTS: The results were based on three consecutive studies which evaluated the influence of TENS on the chewing musculature: 1. Comparison of healthy adults (n = 19) with subjects suffering from nocturnal bruxism (n = 18); 2. Determination of the long-term effect of the electrical stimulation (n = 20); 3. Analysis of electromyographic (EMG) reaction to daily repeated TENS application (n = 20).
METHODS: The myoelectric signals were registered before and after TENS treatment in three different mandibular positions. A Fourier analysis of the power spectrum yielded information on the frequency behaviour of the muscles studied.
RESULTS: A statistical analysis of the data (test of variance) led to the following significant results: 1. TENS initiated significantly lower integrated EMG and higher mean power frequency values. Since this effect is contrary to muscle fatigue, these results can be interpreted as a relaxation of the treated muscles. 2. Two different types of stimulation (high or low frequency) showed the same effects. 3. The relaxation could be identified by means of EMG measurements up to 7 hours after TENS treatment. 4. The effect of relaxation declines significantly if TENS treatment is used daily, probably due to habituation.
CONCLUSION: TENS helps to treat the neuromuscular component in subjects with orofacial dysfunctions. According

to the results the type of stimulation, however, should be varied.

150 TEMPOROMANDIBULAR JOINT REMODELLING IN YOUNG ADULTS TREATED WITH THE HERBST APPLIANCE

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AIM: To compare the temporomandibular joint (TMJ) adaptive mechanisms in young adults and adolescents treated with the Herbst appliance.
SUBJECTS: Fourteen young adult and 25 adolescents with Class II malocclusions treated successfully with the Herbst appliance. Young adulthood was defined by the hand-wrist radiographic stages R-IJ and RJ and adolescence by the stages MP3-E until MP3-G (Hägg and Taranger, 1980).
METHOD: Analysis of magnetic resonance images from before Herbst treatment, at start (when the appliance was placed), after 6–12 weeks of Herbst treatment and after Herbst treatment (when the appliance was removed).
RESULTS: All adult and adolescent subjects were treated to a Class I or overcorrected Class I occlusal relationship. Signs of condylar remodelling were seen after 6–12 weeks of Herbst treatment in 26 of the 28 young adult condyles and in 48 of the 50 adolescent condyles. Signs of glenoid fossa remodelling were noted at the end of treatment in 22 young adult and 36 adolescent TMJs. The appearance of the signs of condylar remodelling differed between young adults and adolescents.
CONCLUSION: Herbst treatment resulted in condylar and glenoid fossa remodelling in young adults as well as in adolescents. As Herbst treatment is most effective in Class II patients and also at the end of the growth period, it could be an alternative to orthognathic surgery in borderline skeletal Class II subjects.

Hägg U, Taranger J 1980 Skeletal stages of the hand and wrist as indicators of the pubertal growth spurt. Acta Odontologica Scandinavica 38: 87–200

151 DENTOSKELETAL EFFECTS AND FACIAL PROFILE CHANGES IN YOUNG ADULTS TREATED WITH THE HERBST APPLIANCE

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AIM: To analyse and compare the sagittal dental and skeletal changes contributing to Class II correction and to assess the effect of Herbst treatment on the facial profile in young adult patients.
SUBJECTS: Fourteen young adults with a Class II malocclusion treated with the Herbst appliance. Twenty five adolescent Herbst patients served as controls. Young adulthood was defined by the hand-wrist radiographic stages R-IJ and RJ and adolescence by the stages MP3-E until MP3-G (Hägg and Taranger, 1980).
METHOD: Lateral headfilms from before and after treatment were evaluated according to the method of Pancherz (1982). Additionally the skeletal and soft tissue profile convexity changes were assessed.
RESULTS: All adult and adolescent subjects were treated to a Class I or overcorrected Class I occlusal relationship. In both groups the improvement in sagittal incisor and molar relationship was achieved by more dental than skeletal changes. The amount of skeletal change contributing to overjet and molar correction was smaller in young adults than in adolescents. Facial profile convexity was reduced in both groups during treatment. The improvement in facial profile did not differ between the groups.
CONCLUSION: The Herbst appliance is most effective in the treatment of Class II malocclusions in young adults and the profile convexity is reduced. It is suggested that Herbst treatment could be an alternative to orthognathic surgery in borderline Class II subjects.

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

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

152 EFFECTS OF LIP BUMPER THERAPY ON UNERUPTED SECOND MOLARS

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AIM: To assess the effects of a lip bumper appliance on unerupted second molars.
SUBJECTS AND METHOD: Ten patients (6 females, 4 males) between the ages of 8 and 12 years (mean 9.5), were treated for mandibular crowding using a lip bumper. Ten untreated patients, 6 females and 4 males of the same age, with the same malocclusion comprised the control group. All patients were Class I with a mild to moderate mandibular arch length deficiency of 4–6 mm and in the mixed dentition stage with unerupted second molars. Lip bumpers were worn full time for 6 months and the patients were recalled every 4 weeks. Response to therapy was evaluated by comparison of the pre- and post-treatment standard lateral cephalograms. Dental changes were measured from the radiographs using angular and linear measurements that were drawn on the reference planes (occlusal, mandibular planes and pterygoid vertical). The data were analysed statistically with paired *t*-tests.
RESULTS: The mandibular first and unerupted second molars moved distally ($P < 0.01$) but did not show any angular movement ($P > 0.05$). Occlusal movement of the unerupted second molars was not statistically significant, and this result was in agreement with the parallel tipping. Distal movement

of first and second molars was also positively correlated. Mandibular incisor measurements were in agreement with the literature. In comparison with the control group all results were statistically significant.
CONCLUSION: This prospective study demonstrates that the lip bumper appliance can be safely used to resolve mild to moderate mandibular arch crowding during the mixed dentition period without any detrimental effect on the unerupted second molars.

153 DERMATOGLYPHIC PATTERN AND CLEFT PALATE: CLINICAL EVALUATION

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AIM: To present dermatoglyphic evaluation of cleft palate patients as an aid in the detection of growth problems.
SUBJECTS: Thirty seven cleft palate patients were evaluated over a 10-year period to compare growth.
METHODS: In patients with altered dermatoglyphic patterns a genetic investigation was performed. When a syndrome could be identified, the patient was excluded from the study. The growth evaluation was performed on cephalograms using Sassouni's analysis. Surgery was undertaken at the same age by the same surgeon and the orthodontic treatment was followed by the same team. The cephalometric analysis was performed by one examiner.
RESULTS: The rate of growth anomalies (delay, change of growth direction) was coherent with dermatoglyphic pattern alterations. The meta-analysis showed, despite a high dispersion of the examined group, a significant correlation between growth disturbances and hand-finger markings. Six patients were lost during the study.
CONCLUSION: The evaluation of dermatoglyphic patterns is easy to perform and teach. The high rate of false positives still requires a deeper evaluation of concomitant signs.

154 EFFECTS OF AN ORAL APPLIANCE IN OBSTRUCTIVE SLEEP APNOEA

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INTRODUCTION: Obstructive Sleep Apnoea (OSA) is a complex syndrome occurring during sleep in which periods of cessation of at least 10 seconds in breathing occur despite inspiratory effort. Treatment is warranted due to excessive daytime sleepiness and increased risk of cardiovascular problems. Standard treatment is continuous positive airway pressure, which is effective but often with sub-optimal compliance. An oral appliance has been reported to have a higher compliance, but its efficacy is not well delineated, especially in non-Caucasian patients.
AIM: To assess the effects, compliance and side-effects of an oral appliance in the treatment of OSA in Chinese subjects.
SUBJECTS: Thirty Chinese patients from the Sleep Related Breathing Disorders Clinic. Seventeen patients (13M and 4F) were studied. Their mean age was 49.4 years and they had a mean body mass index of 25.8.
METHODS: An oral appliance was fabricated after obtaining baseline measurements following a comprehensive overnight sleep study, cephalometric computer tomography, radiography and questionnaires. Re-assessment was conducted 6 weeks later.
RESULTS: With use of an oral appliance, all patients reported a significant improvement in the symptoms. The Epworth Sleepiness Scale reduced from 12 to 7.2 while the mean AHI (Apnoea/Hypopnoea Index—the number of apnoea and/or hypopnoea episodes in 1 hour) reduced from 23.5 to 10.8. Transient discomfort was resolved after some adjustments and the compliance was 6.6 nights/week.
CONCLUSIONS: The oral appliance is an effective alternative in the treatment of OSA in Chinese subjects. The side-effects are minor and only temporary. The compliance is excellent.

155 THE RETENTIVE ABILITY OF A LOCKING ORTHODONTIC FACEBOW

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AIM: To determine whether the addition of bilateral locking catches to an orthodontic facebow would prevent the facebow from coming out of the buccal tubes at night thereby improving safety and patient compliance. Historical questionnaire controls have reported detachment of standard orthodontic facebows in up to 65 per cent of extra-oral traction patients.
METHOD: A prospective multi-centred study of 706 consecutive patients treated over a 2-year period. Twelve orthodontists in different clinical practices fitted the locking orthodontic facebow to all their extra-oral patients. The ability of every patient to fit and use the facebow was assessed by each clinician. At each review visit every patient was questioned regarding any possible detachment of the facebow at night, or any problem experienced, and the facebow and extra-oral traction were checked. All details were recorded. The study covered approximately 166,500 nights of extra oral traction wear.
RESULTS: All orthodontists were able to use the facebow. No patient withdrew from the study due to inability to successfully use and wear the locking facebow. The introduction of a bilateral locking mechanism, when correctly fitted, reduced the reported detachment of the facebow to less than 1 per cent. This involved 12 out of 166,500 nights.
CONCLUSION: The introduction of bilateral locking catches to a standard facebow greatly improves retention at night with a minimum of problems. This increased retention improves patient compliance and facebow safety.

156 STRESS DISTRIBUTION IN THE PERIODONTAL LIGAMENT INFLUENCED BY ROOT CONFIGURATION

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AIM: To investigate the relationship between tissue response under different types of the root configuration and the stress distribution in the periodontal ligament (PDL). The histological observations were compared with the analytical findings obtained by a specimen-specific finite element (FE) model.
MATERIAL AND METHODS: The maxillary canines of adult cats, which have an ellipsoid shape, were continuously moved by an initial force of 100 g for 14 days using springs. To investigate the influence of root configuration, two directions of the force were designed. One gave distal movement, which was in the direction of the long diameter, and the other buccal movement, which was in the direction of the short diameter. After fixation, the canine and the surrounding tissues were embedded in celloidin. Cross tissue sections were obtained and stained with haematoxylin and eosin. Based on four tissue sections of each, specimen-specific 2-D FE models were constructed. The values of Young's modulus were 0.37 MPa (tensile region) and 0.079 MPa (compressive region), and Poisson's ratio was 0.45 in the PDL according to a recent study. The principal stress distribution within the PDL obtained by each 2-D model was then compared with the distribution of osteoclast appearance and the degenerated tissue for each corresponding tissue section.
RESULT: From the stress distribution of each tissue section, it was found that most of the osteoclasts appeared around the range –4 kPa of the stress level. In both distally and buccally moved sections, the stress distribution was higher than the range, and degenerated tissue appeared widely in the distally moved sections in comparison with the buccally moved sections.
CONCLUSION: Stress distribution in the periodontium depends on root configuration. Root configuration should be taken into consideration when applying orthodontic force.

157 APICAL ROOT RESORPTION IN MAXILLARY CLEFT SIDE TEETH AFTER TREATMENT WITH FIXED APPLIANCES

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AIM: To determine the frequency distribution and degree of root resorption among incisors, either on the cleft or non-cleft side, and to determine which of the selected patient-specific and treatment-dependent factors are evidently connected to the pathological findings.
SUBJECTS AND METHODS: Forty one patients with unilateral cleft lip and palate were examined after completion of treatment with fixed appliances. Frequency and extent of root resorption were analysed using a visual score-system, which registers changes of crown-root relationships and of contours in the apical third of the roots on the basis of panoramic tomography. The post-treatment length of the teeth was measured with the aid of standardized enoral radiographs. Plaster models served to determine the degree of tooth movement in mesio-distal and labial-palatinal directions and the extent of rotational movement. Statistical evaluation was performed. Regression models were used to describe the influence of selected clinical parameters on loss of root substance.
RESULTS: The degree and extent of apical root resorption in the central incisors and canines on the cleft side was significantly larger in comparison with those of the non-cleft side ($P < 0.01$ or $P < 0.05$, respectively). The metric evaluation of 69 pairs of teeth demonstrated a definite tendency for shorter lengths of cleft side incisors. This result was highly statistically significant for the group of central and lateral incisors ($P < 0.001$ or $P < 0.01$, respectively). There existed, for all examined groups of teeth, a verified correlation between the extent of post-treatment root loss and indications of resorption prior to treatment with fixed appliances. Abnormal root formations, the length of the entire treatment and the extent of labio-palatinal tooth movement also had a significant influence on the size of the resorption score, though only with reference to single groups of teeth.
CONCLUSION: Unilateral cleft patients run a verified higher risk of therapeutic dependent loss of root structure in cleft side incisors.

158 OUTCOME OF AUTOTRANSPLANTATION IN ORTHODONTIC TREATMENT PLANNING FOR CONGENITALLY MISSING TEETH

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AIM: Missing teeth often present a difficult problem for orthodontic treatment planning. In the mixed dentition, the use of autotransplantation can often re-establish the symmetry of the dental arch where purely orthodontic space-closing methods would have failed. Against this background, the outcome of autotransplantation to replace missing teeth was investigated.
SUBJECTS: Fifteen autologous tooth transplants in 10 patients with congenitally missing teeth were carried out. Their average age was 13 years (range: 11–18 years). The average post-treatment time to follow-up was 1.5 years (range: 0.34 years).
METHODS: The following parameters were investigated at follow-up: clinical mobility, Periotest, sensitivity testing, sulcus fluid flow rate (SFR), periodontal sulcus depth, periodontal bleeding index (PBI) (Saxer/Mühlemann), and Helkimo Index (Lindhe). The contralateral teeth in the same

patient were used as controls. Evaluation of the bony regeneration of the peri-transplant defect was based on roentgenologic investigations using self-made grid templates on the 7th post-operative day, and after 1, 3 and 6 months. On the occasion of the follow-up examination, the overall defect and the area of the transplanted tooth root was calculated on the basis of standardized dental films, and the residual defect was determined. The radiographic images were examined for the presence of a periodontal ligament space, an internal lamina dura, resorption of the transplant root and obliteration of the pulp canal, periodontal bony defects and continuation of root growth. The criteria for successful transplantation were defined as: mobility < 1, Periotest < 20, SFR < 40, periodontal sulcus depth < 3 mm, occlusal loadability, and absence of pain.
RESULTS: On the basis of these criteria, the successful outcome of autotransplantation in congenitally missing teeth was 80 per cent (12 out of 15).
CONCLUSION: Provided that the indication is carefully established and the operative procedure is meticulously performed, autotransplantation represents a useful addition to the spectrum of orthodontic treatment options. In the mixed dentition in particular, autotransplantation can, in contrast to implants, avoid inhibition of the vertical development of the alveolar arch.

159 INFLUENCE OF MENTAL LOAD ON MASTICATORY MUSCLES IN PATIENTS WITH CRANIOMANDIBULAR DYSFUNCTIONS

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AIM: Mental and physical load influences the activity of different muscles in the human organism, but humans do not generally respond in the same way. The aim of this study was to investigate a specific response of chewing muscles on the mental load of patients suffering from craniomandibular dysfunctions (CMD).
SUBJECTS: Seventy CMD patients (54 females, 16 males) and 20 healthy volunteers.
METHOD: From the right and left masseter and the anterior temporal and digastric muscles, surface electromyography (EMG) was bipolarly recorded at rest and during mental load (arithmetic chain task, timing 2.8 seconds). The subjects were in an upright position in a dental chair with their head supported. The EMG was recorded with the mandible in postural position and during natural chewing of crisp bread. ECG and respiratory movements were also recorded simultaneously in order to verify the influence of mental load.
RESULTS: During mental load the mean heart rate increased significantly by 10 min^{-1} and the mean respiration rate by 4 min^{-1}. Even at rest the mean amplitude of postural activity in the masseter muscle and partly in the anterior temporal muscle was significantly higher in CMD patients than in the healthy volunteers. During mental load the mean postural activity increased in both groups, but more in the CMD patients than in controls. Moreover, the number of short augmentations of the postural activity increased significantly in both groups under the influence of a mental load. However in CMD patients they were found more frequently and for a longer total duration. During natural chewing in CMD patients, even in those who were without pain at the time of examination, a considerably lower muscle activity was recorded than in healthy volunteers.
CONCLUSIONS: The muscular tonus of chewing muscles increases under the influence of mental load, but CMD patients show a specific response on physical loading. In future, it could be helpful to characterize intramuscular differences of muscle activation, for example, by means of the topographic orientated EMG mapping. The diminished chewing potential in CMD patients is probably due to changes of the motor command programme in the central pattern generator caused by learning events which avoid pain.

160 EXTREME SHORT ROOT ANOMALIES—EVALUATION OF A SURVEY AT GERMAN UNIVERSITIES

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AIM: Disturbances in root development are a rare finding when orthodontic anamnestic records are evaluated. One reason might be that orthodontic treatment started in a phase where roots formation was incomplete so that later no distinction is possible between treatment influences and predetermined disturbances of the root development. In our clinic only one girl suffers with a distinct dentinal dysplasia type I with the characteristic of no root formation.
MATERIAL: To obtain more information concerning different influences on root development and especially a more detailed picture by panoramic radiographs, a questionnaire was sent to all German universities, asking for extreme root configurations before orthodontic treatment. Only the radiographs and patient gender and age were requested, not the medical history.
RESULTS: From the 32 letters a response was received from 13 universities. Five could not contribute, the other eight sent altogether 14 cases. The ages ranged from 7 to 21 years. It seems that more females are affected. Two radiographs showed a generalized type of dentinal dysplasia, but in the majority of subjects only certain teeth were affected, namely premolars. Three cases showed a prevalence in the lower jaw, whereas only one subject had limited root development or resorption of the upper anterior teeth which had probably resulted from external factors such as chemo- or X-ray therapy and might have caused arrested root development in correspondence to the treatment time and the patient's dental age.
CONCLUSION: Assuming that subjects with short or abnormal root form are often transferred to university facilities, findings of extreme root shortening seem to be a

rare occurrence. However, minor forms should also be recognized before orthodontic treatment is commenced so that the risk of further damage of the periodontal support of the affected teeth can be minimized. Well documented records for treatment planning are also essential for forensic reasons.

161 A MODIFIED LOOP IN ROOT TIPPING CONTROL USING THE PENDULUM APPLIANCE

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AIM: To determine the efficiency of a reverse modified loop of the Pendulum appliance in root tipping control during distalization.
MATERIAL: Twenty modified Pendulum appliances were used in Class II treatments without extractions.
METHODS: The appliances were activated extra-orally, bending the terminal springs approximately 40–45 degrees, and subsequently bonded. The activation was repeated monthly until space gain was sufficient for orthodontic anterior tooth retraction. At the end of distal movement the terminal springs were de-activated and a passive fit into lingual sheaths was obtained. The activation of the reverse loop was performed by bending it with Weingart pliers. After 1 month two intraoral radiographs were taken of both sides to evaluate if distal tipping of the first molar roots had occurred and subjectively evaluated.
RESULTS: In all the treated cases (100 per cent) the molar distalization occurred by means of a compound bodily movement. The intraoral radiographs showed a close parallelism of the first molar root complex to the second molar. There was no significant widening of the periodontal ligament space at the end of the distalization period.
CONCLUSIONS: In comparison with Hilger's Pendulum appliance the modified loop version allows improved control of distalization by means of a direct action on the root complex. This result emphasizes some advantages achieved with this technique including more stable anchorage.

162 FROM TWO-DIMENSIONAL ANALYSIS ON THE LATERAL RADIOGRAPH TO THREE-DIMENSIONAL REPOSITIONING IN MAXILLARY SURGERY

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AIM: During orthodontic-surgical treatment three-dimensional (3D) repositioning of the maxilla is required after Le Fort I osteotomy. The pre-operative planning usually involves a two-dimensional lateral radiograph. On the lateral radiograph, the movement of the maxilla in the sagittal and vertical planes can be simulated, and the position of the osteotomy line in relation to the occlusion can be determined. However, the lateral radiograph consists of two dimensions, whereas, during surgery, three dimensions have to be considered. The contour of the lateral surface of the maxilla and its individual regional variations are not reflected on the lateral radiograph. Therefore, this third dimension's influence on treatment planning was investigated.
MATERIALS AND METHODS: Lateral radiographs were taken of 20 skulls. An individual impression tray was prepared from self-curing resin and impressions were taken of the maxilla and maxillary teeth. Casts were fabricated, and cuts were made in the transverse vertical plane at the level of the tips of the canines and the mesio-buccal cusps of the first molars bilaterally. Contour lines of the lateral surfaces of the cuts in the areas of the molars and canines were drawn with a pencil on graph paper. Reference lines were drawn on tracings of the lateral radiographs perpendicular to the occlusal plane from the tips of the canine and mesio-buccal cusp of the first molar to the maxilla. The lengths of these reference lines were chosen as tooth length plus 2 mm and tooth length plus 4 mm. They were transferred from the lateral radiograph to the contour lines on the graph paper using a calliper.
RESULTS: Calculation of the discrepancies in the position of reference points and lines after the transfer from two- to three-dimensions revealed, for example, for the first molar, differences up to 3.3 mm.
CONCLUSIONS: It is not possible to transfer reference points and reference lines from the lateral radiograph to the maxilla nor to move the mobilized maxilla along the planned osteotomy lines in a precise manner. It is only possible to indicate the general direction of the osteotomy lines. The results of this study show the necessity for precise control methods for 3D positioning of the maxilla during treatment planning, cast surgery, and actual surgery. This is possible, for example, by application of the Goettingen concept for 3D positioning of the maxilla using the 'model-repositioning instrument' for cast surgery and the '3D double splint method' for a controlled 3D positioning of the maxilla during surgical procedure with an accuracy of ±1 mm sagittally and vertically.

163 A QUANTITATIVE STUDY OF ORTHODONTIC TOOTH MOVEMENT FOLLOWING INJECTION OF PGE_2 AND CALCIUM GLUCONATE IN WISTAR RATS

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AIM: To determine quantitatively orthodontic tooth movement following injection of PGE_2 and PGE_2 plus calcium gluconate.
MATERIAL: Twenty four Wistar rats (male, 8 weeks old, body weight = 260 ± 30 g.)
METHODS: The rats were divided randomly into three groups. For all groups a similar appliance (closed coil spring) was used. The closed coil spring was tied to upper right first molar then pulled (force equal to 60 g) and tied to the right

incisor. The first group (control) did not receive any drug. The second group received a submucosal injection of PGE_2 on days 0 and 7. In addition to PGE_2, the third group received a 1M injection of calcium gluconate. On day 21 all the animals were sacrificed and the distance between upper right first and second molars was measured by special gauge. The data of the three experimental groups were analysed by Statgraphics software. According to the Stat Advisor, the Kruskal-Wallis test was suggested for testing the null hypothesis.
RESULTS: The data from all levels were first combined and ranked from smallest to largest. The average rank was then computed for the data at each level i.e. control group =7.9375, PGE_2 group = 16.25, and PGE_2 + calcium gluconate = 15.625). Since the *P*-value was less than 0.05 (i.e. 0.0446916) there was a statistically significant difference amongst the medians at the 95 per cent confidence level. To determine which medians were significantly different, a box and whisker plot was selected from the list of graphical options and the median notch option was selected.
CONCLUSION: As a primary messenger, PGE_2 can increase tooth movement. Calcium not only has benefits for reducing root resorption (subject of further research) and osteoporosis (bone resorption) but can also decrease tooth movement.

164 DETERMINATION OF TOOTH ANGULATION IN DENTAL COMPUTER TOMOGRAPHY

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AIM: In order to achieve anatomically correct measurements of the tooth axes in dental computer tomography (CT), a standard evaluation framework is necessary because of the impossibility of fixing the patient's head in the scanner.
MATERIAL: A macerated skull and 23 patients with full dentitions.
METHODS: A macerated skull with a titanium plate in the occlusal plane was scanned in four different positions. In this presentation an example is given by the images of the skull tilting 7 degrees to the left. In the first step the angulations of the teeth were measured to the horizontal edge of the panoramic and paraxial CT reformations (original measurements). These values were entered into a self-developed angulation correction programme based on a defined reference plane (occlusal plane). The corrected values were then compared with the original measurements and with the values obtained by measuring the angle between the tooth axes and the titan plate (control measurements). The results were analysed statistically. In addition, the CT images of 23 patients with partially misplaced teeth were analysed analogously.
RESULTS: For the macerated skull the difference between the corrected values and the control measurements was up to 1 degree. However the difference between the original measurements and the corrected values was up to 7 degrees. On the panoramic images the greatest deviation could be seen in the anterior area and in the para-axial images in the posterior area of the dental arch. For approximately 67 per cent of patients the tooth axes could be measured easily, whereas determination of the tooth axes was insufficient in 33 per cent of the measured teeth.
CONCLUSION: Overall, the dental CT is most suitable to find the topographical location of misplaced and impacted teeth. The angulation correction programme, especially developed for this application, guarantees an exact metric analysis of tooth angulation independent of the patient's position in the CT. The dental CT and the angulation correction programme form an optimal diagnostic instrument for pre-surgical planning and for orthodontic procedures, especially in subjects with misplaced teeth.

165 ANATOMIC STRUCTURE OF THE FACE AND OCCLUSAL RELATIONSHIP IN CHILDREN BORN PREMATURELY AND ON TIME

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AIM: The determination and comparison of occlusal relationships and anatomic structures of children born prematurely and on time.
SUBJECTS: One hundred and twenty children 6 years of age, 60 of whom were born on time and 60 prematurely (between the 28th and 36th week of pregnancy).
METHOD: Anatomy of the face was determined according to the method of Martin and the morphological index according to Garson and Saller. The transverse-longitudinal index of Saller, and Izard's index were also determined. Occlusal relationships were assessed in relation to the three Simon's planes.
RESULTS: Malocclusions were registered in 30 children (50 per cent) born on time and in 46 children (77 per cent) born prematurely. It was found that malocclusion was more frequent in dolicho- and brachyo-cephalic children. For dolichocephalic children malocclusion was registered in 83 per cent of prematurely born children and in 57 per cent of children born on time. For brachyocephalic children malocclusions were found in 79 per cent of children born prematurely and in 50 per cent of children born on time.
CONCLUSION: Although all the reasons affecting formation of occlusal relationships in children born prematurely have not yet been clarified, the more frequent malocclusions found in these children indicate that they require special orthodontic care.

166 ORTHOGNATHIC SURGERY COMPUTERIZED PLANNING—ASSESSMENT OF SOFT TISSUE PREDICTION ACCURACY

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AIM: To evaluate the accuracy of the soft tissue profile prediction by using computerized diagnostic and planning software (OTP, OrthoVision) in orthognathic surgery procedures.
MATERIAL: Pre-orthodontic (T1), pre-surgical (T2) and post-surgical (T3) lateral cephalograms of 38 patients (10 male, 28 female) who had completed treatment involving orthodontics and bimaxillary surgery were examined.
METHOD: Hard and soft tissue landmarks were digitized using the on-screen facility for each cephalogram and computer predicted image. A customized analysis was used to analyse the differences between the actual measurements and the computer predicted landmark measurements.
RESULTS: Mean differences were assessed both in the horizontal and vertical planes between the actual and predicted images. Predictors in the horizontal plane were found to be more accurate than those in the vertical plane. Horizontally the nasal tip and upper lip position were the most accurately predicted with the lower lip and chin positions showing greater variability. The largest mean difference between the predicted and actual image was only 1.9 mm (surgical prediction of pogonion in the vertical plane).
CONCLUSION: The computer program is reasonably accurate in predicting soft tissue images. The upper lip and nose are the most accurately predicted whilst the lower lip and chin are less predictable. These differences may be attributed to the inaccuracy of the pre-programmed soft to hard tissue ratios when predicting soft tissue response. Nevertheless, it is a useful tool to aid communication between clinician and patient by establishing visual treatment goals for orthodontic treatment and orthognathic surgery.

167 THE CERVICAL VERTEBRAE (C3) IN SKELETAL AND SOMATIC MATURATION EVALUATION

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AIM: To ascertain if analysis of C3 cervical vertebrae development, is reliable and valid in the assessment of skeletal and somatic maturity.
MATERIAL: Individual velocity growth curves of standing height and 5–14 lateral head films from each of 48 subjects covering the age span of 8–22 years. A total of 401 radiographs were available.
METHOD: Analysis of the lateral head films with respect to C3 development using the six stages of Hassel and Farman (1995). The reliability of the C3-method was assessed by repeating the registrations four times and measuring the number of coinciding recordings. The validity of the method was assessed by relating the C3 stages in each individual to three growth periods defined on the growth curves: Pre-Peak, Peak and Post-Peak (Pancherz and Hägg, 1985).
RESULTS: For the six C3 developmental stages the reliability of the analysing method ranged between 88 and 93 per cent. The validity assessment revealed the following: the combined stages 1 and 2 coincided with the Pre-Peak growth period in 83 per cent of the registrations; combined stages 3 and 4 coincided with the Peak growth period in 74 per cent of the registrations and combined stages 5 and 6 with the Post-peak growth period in 85 per cent of the registrations
CONCLUSIONS: The reliability and validity of the C3 analysing method is acceptably high and could replace the hand radiographic approach in the assessment of skeletal and somatic maturity.

Hassel B, Farman A G 1995 Skeletal maturation evaluation using cervical vertebrae. American Journal of Orthodontics and Dentofacial Orthopedics 107: 58–66

Pancherz H, Hägg U 1985 Dentofacial orthopedics in relation to somatic maturation. American Journal of Orthodontics 88: 273–287

168 BOLTON'S RATIO AMONG SOUTHERN CHINESE

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AIM: To quantify Bolton's (1952) anterior and overall ratios for Southern Chinese and to compare them with those found by Bolton.
MATERIAL AND METHODS: Fifty plaster casts of subjects with a Class I occlusion and a dental stage of DS4M1/M2 were selected from a random sample of 1,247 12-year-old Hong Kong Chinese children. All teeth to be measured had to be free of malformation, noticeable fractures, caries and restorations. The means, standard deviations, and ranges were calculated for the Bolton ratios.
RESULTS: The anterior and overall ratios in this study were found to be 77.6 ± 1.80 and 90.9 ± 1.41, respectively. The range for the anterior ratio was from 74.2 to 81.5, and for the overall ratio from 87.3 to 92.5. Bolton's means are 77.2 ± 1.65 and 91.3 ± 1.91, and the ranges from 74.5 to 80.4 and 87.5 to 94.8.
CONCLUSION: The values from this study are comparable with those of Bolton.

169 RELATIONSHIP BETWEEN ABORIGINAL CROWDING AND LONGITUDINAL CHANGES OF AVAILABLE SPACE

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AIM: To clarify whether other factors, besides the deficiency of available space, are involved in the development of crowding.
MATERIALS AND METHODS: One thousand seven hundred and eight intraoral plaster models from three age

groups (7–9, 11–12 and 14–16 years of age) impressed from 444 traditional Australian Aborigines who had not received any dental treatment. They were first classified into four groups, i.e. dentition with crowding throughout three ages (C-C group), dentition with change from crowding to normal occlusion (C-N group), dentition with change from normal occlusion to crowding (N-C group), and dentition with normal occlusion throughout three ages (N-N group). Each was analysed by calculating the anterior available space (available space—the sum of mesio-distal crown width of U and E) and anterior discrepancy (anterior available space—the sum of the mesio-distal crown width of the central and lateral incisors). The outline of each tooth traced from photographs was superimposed on each age of plaster models which had one case selected out of 9–12 typical cases.
RESULTS: 1) Available space in the N-N group was wider than that in the C-C and C-N groups throughout three ages. The sum of the crown width of the upper or lower four incisors was larger than those in the N-N and C-N groups. 2) Female lower anterior available space in the C-C group at 7–9 years of age was, contrary to expectations, wider than that in the N-N and C-N groups. 3) Lower anterior discrepancy exhibited minus value in the C-C, C-N and N-N groups. These discrepancies in the male C-C and C-N groups were larger than that in the N-N group, while those in all three female groups were almost the same, contrary to the commonly accepted theory.
CONCLUSION: Other factors, besides the deficiency of available space, are involved in the development of crowding.

170 THREE-DIMENSIONAL RECONSTRUCTION OF OSTEOCLASTS AFTER TOOTH MOVEMENT

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AIM: To demonstrate the three-dimensional (3D) images of osteoclasts in the periodontium after orthodontic tooth movement.
MATERIALS: Rat maxillary molars were moved by insertion of band material and the cytochemical localization of tartrate-resistant acid phosphatase (TRAP) products was detected in osteoclastic cells by confocal laser scanning microscopy (CLSM).
RESULTS: TRAP activity was detected in mono- and multi-nuclear cells, such as osteoclasts, odontoclasts, foreign body giant cells and fibroblasts, in the pressure area of the periodontium. In contrast, no enzyme activity was seen in any cells of the tension area. In the 3D images, TRAP-positive multi-nuclear cells were various in shape and possessed a villiform and plate-like 'ruffled border' or wavy, pad-like processes.
CONCLUSIONS: Enzyme fluorescence of TRAP is intensely detected in mono- and multi-nuclear cells. The 3D reconstruction, viewed from bone or root matrix site with CLSM, is useful to analyse the contour of multi-nuclear cells.

171 EFFECTS OF REDUCTION IN TONGUE SPACE

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AIM: To elucidate the changes in pharyngeal airway and hyoid bone position with experimental reduction in tongue space.
MATERIALS AND METHOD: Lateral cephalograms of 30 subjects with experimental reduction of the tongue. The cephalometric analyses were performed with linear and angular measurements. All the data were compared using ANOVA and a Student's *t*-test.
RESULTS: When the tongue space was reduced by 5 mm, significant changes were found in the pharyngeal airway, such as anteroposterior constriction at the middle to lower portion, reduction in the area at the middle portion, and superioinferior extension at the lower portion. The hyoid bone position changed downwards. A 10 mm reduction in tongue space caused significant morphological changes in the pharyngeal airway, one to two times as large as those cases with a 5 mm reduction. A significant decrease was also found in the superioinferior dimension of the airway at the middle portion. The changes in the hyoid bone position were upward as compared with those with a 5 mm reduction.
CONCLUSION: These findings indicate that it may be useful for a good orthodontic result to pay attention to the morphology of the pharyngeal airway and hyoid bone position in diagnosis, and to estimate its change with a reduction in tongue space in treatment planning.

172 ORTHOSYSTEM® IMPLANTS FOR ORTHODONTICS—PRACTICALITY OF THE SURGICAL PROCEDURE

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AIM: Maximal posterior anchorage is a critical problem for the orthodontist when teeth have to be maintained in their position. The purpose of this study was to evaluate the efficacy of the Orthosystem® implant (Institut Straumann, Waldenburg, Switzerland) when maximum anchorage of posterior teeth is required.
SUBJECTS: Eight patients, with a severe Angle's Class II division 1 malocclusion, at the end of their growth, undergoing orthodontic treatment with extraction of the upper first premolars.
METHODS: Orthosystem® implants measuring 4 and 6 mm in height with a diameter of 3.3 mm were placed in the medial palatal suture. The surgical procedure was carried out using only three drills without elevating a flap. The duration of the surgery, after application of local anaesthesia, was, on average, 5 minutes.

RESULTS: The post-operative period was uneventful. Two months following surgery, a transpalatal bar was bonded on the posterior teeth and fixed to the implant. All implants osseointegrated.
CONCLUSION: Placement of an Orthosystem® implant is a practical and easy procedure that can be easily performed by an orthodontist when maximal anchorage is required.

173 LONG-TERM FOLLOW-UP OF EARLY TREATMENT OF UNILATERAL FORCED POSTERIOR CROSSBITE

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AIM: To study the long-term outcome of early unilateral crossbite treatment.
SUBJECTS: Twenty nine Swedish young adults, 20 years old on average, all treated at 4 years of age for unilateral forced posterior dentoalveolar crossbite by grinding or by expansion of the upper dental arch.
METHODS: Anamnestic information concerning previous orthodontic treatment and breathing function was collected. Transverse occlusal relationship was registered from model casts and clinically. Masticatory performance, bite force and mandibular asymmetry were assessed. *t*- and Chi-tests were used for statistical analyses.
RESULTS: The frequency of successful treatment, indicated as a stable correction of the crossbite, by means of only one treatment sequence was 59 per cent; by grinding, 57 per cent; and by expansion, 60 per cent. Subdividing the subjects into two groups concerning treatment sequences, a significantly higher frequency of mouth breathing, breathing obstacles, and snoring was found in the re-treated group. The findings regarding masticatory performance and bite force showed no significant differences between the initial crossbite and the healthy side or between the early-treated and the re-treated subjects, which showed that the masticatory function of the subjects was symmetrical. The majority of the subjects (86 per cent) showed no obvious mandibular asymmetry.
CONCLUSIONS: Mode of breathing and breathing obstacles seem to play an important role in the origin and persistence of a crossbite and also have an effect on the success rate of treatment and stable crossbite correction. Grinding and expansion treatments seem to display similar success rates.

174 ORTHOGNATHIC SURGERY, PHARYNGEAL AIRWAY DIMENSIONS AND SLEEP QUALITY

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AIM: To prospectively examine airway dimensional changes associated with orthognathic surgery, and the relationship of these changes to sleep quality.
SUBJECTS: Twenty eight Caucasian subjects scheduled for surgery (mean age 22.9 years).
METHODS: Lateral cephalometric radiographs were traced and digitized before and 6 weeks after orthognathic surgery, and the oropharyngeal airway morphologies compared in two groups (12 Class II, 16 Class III subjects). A questionnaire was used to assess changes in daytime sleepiness and snoring incidence. Additionally, nine of the mandibular surgery subjects were assessed by overnight domiciliary sleep monitoring (respiratory sound and pulse oximetry).
RESULTS: A significant decrease in the retro-lingual airway dimension was found in all subjects after mandibular setback surgery ($P < 0.01$, Class III group) and a significant increase in this dimension after mandibular advancement ($P < 0.01$, Class II group). Maxillary advancement surgery caused no changes in retro-palatal dimension when performed in isolation or combined with a mandibular setback. The questionnaire and sleep study revealed no significant changes in snoring incidence or apnoeic events after mandibular setback surgery. After advancement surgery sleep quality of pre-existing habitual snorers improved.
CONCLUSIONS: The mandibular setback surgery produced a significant radiographic narrowing of the pharyngeal airway posterior to the tongue base. However, in the short term, for this young healthy population the significance in relation to sleep quality is probably low. In the longer term the effects of airway dimensional changes may become more important as with age individuals often embody more of the risk factors for sleep related disorders. The increase in airway dimensions after advancement surgery indicates a therapeutic role in sleep apnoea.

175 DENTAL AGE ASSESSMENT IN A BELGIAN POPULATION

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AIM: To validate the accuracy of the dental age assessment by the method of Demirjian *et al*. (1973) for a Belgian population.
MATERIAL: Orthopantomograms (OPGs) of 2,471 healthy Belgian subjects were collected. A first sample consisted of 2,116 OPGs of 1,029 boys from 1.84 to 17.98 years and 1,087 girls from 2.11 to 17.98 years, and a second sample of 355 OPGs of 195 boys aged 2.27 to 17.38 years and 160 girls from 2.04 to 17.93 years. All OPGs were taken between 1988 and 1998 at the University Hospital in Leuven.
METHODS: In a first part of the study the dental age was assessed on 2,116 OPGs using the method of Demirjian. The chronological age of the subjects when the OPG was taken was compared with the age predicted by the method by a signed-rank test for boys and girls separately. A weighted ANOVA was performed to adapt the scoring system for this European population. In a second part of the study the accuracy of this new system was tested on 355 OPGs by a signed-rank test for both sexes separately and was compared with the accuracy of the original method tested on the same

group. The Bonferroni correction for multiple testing was applied.
RESULTS: Compared with chronological age the dental age gave an over-estimation ranging from 0.19 years (in the youngest age group of the boys) to 1.00 years (in the 8–9-year-old group of the boys). Almost all over-estimations were statistically significant. In the 14–15-year-old boys, an underestimation was found due to the borders of the original conversion tables. New table of age scores were constructed from this sample. The accuracy of the ages predicted with the new tables was higher than when predicted with the original tables.
CONCLUSION: A new scoring system for dental age determination that provides more accurate predictions in a Belgian population has been developed.

Demirjian A, Goldstein H, Tanner M 1973 A new system of dental age assessment. Human Biology 4: 219–227

176 NICKEL RELEASE CONNECTED TO ACIDIC CORROSION OF (SUPER)ELASTIC ORTHODONTIC ARCHWIRES

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AIMS: Immune response, or contact dermatitis, caused by nickel has often been reported during the use of conventional orthodontic appliances (stainless steel wires, custom-made headgear or lip retractors, retainers and brackets). The new (nickel-titanium alloy) generation of archwires operate by means of the activation of a martensitic reaction. All these wires constitute a constant force in a wide range of deflection, requiring the wire to remain in the mouth for a long period.
METHOD: Archwire products were tested with the ion probe analysis. Five of them showing the same distribution pattern were exposed to an acid corrosion test. The surface changes were analysed by scanning electron microscopy.
RESULTS: The dissolved nickel was calculated by the surface unit. The different samples showed a release ($\mu g/cm^2$) as follows: Ni-Ti 0.259, Copper Ni-Ti: 0.535, Neo Sentalloy: 1.973, Sentalloy 5.284, Rematitan Light 34.736. The morphology of surface changes related to the amount of dissolution indicated a type of flattening of the roughness, which was especially observed in Sentalloy and Rematitan Light wires.
CONCLUSIONS: The results indicate that elastic archwires, based on nickel-titanium alloys, used in their 'as-received' condition, may corrode in the oral environment releasing remarkable amounts of nickel, and can cause biological reactions, including local contact hypersensitivity. Nevertheless the constant emission of nickel is probably below the average dietary intake, excluding systematic effects. The surprising result is that despite the same chemical composition, the amount of nickel dissolved showed a wide difference (even 1,000 times) in range, which is probably due to the physical procedure used during the manufacture of different products.

177 ORTHODONTIC TREATMENT NEEDS IN SCHOOLCHILDREN IN SOUTH EAST MEXICO CITY

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AIMS: To assess the need for orthodontic treatment in schoolchildren in South East Mexico City.
SUBJECTS AND METHODS: A random sample of 176 schoolchildren between 10 and 12 years of age without a previous history of orthodontic treatment derived from a preventive dental programme. The Index of Orthodontic Treatment Need (IOTN) was used by two previously calibrated examiners in order to estimate the orthodontic treatment need. The index has two components, the Aesthetic (AC) and Dental Health (DHC). The DHC is divided into five grades: Grade 1 none, grade 2 little, grade 3 moderate, grade 4 great, and grade 5 very great. Additionally the subjects were to give their own view on their dental appearance on a scale of 1–10 by mean of photographs of the AC.
RESULTS: Differences between boys and girls were not statistically significant and the ratings for the DHC of IOTN for the schoolchildren were 34.2 per cent in need of treatment, 57.6 per cent borderline need, and 8.2 per cent no need for treatment. The second component was not recorded because the subjects had difficulty in understanding the AC of IOTN.
CONCLUSION: Based on the findings of this study, it is suggested that the DHC of IOTN is a good tool to assess the need for orthodontic treatment.

178 RADIUS UNION AS AN INDICATOR FOR COMPLETION OF VERTICAL DENTOALVEOLAR GROWTH

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PROBLEM: The placement of a tooth implant before cessation of vertical dentoalveolar growth leads to infra-occlusion of the artificial tooth.
AIM: To ascertain if the skeletal maturity stage, Radius union (R_u), can be used as indicator for vertical dento-alveolar growth completion.
MATERIAL: Hand-wrist radiographs and lateral head films taken at the same occasion from 56 subjects (31 males and 25 females) > 3 years out of orthodontic treatment. From each individual three to four pairs of radiographs existed with approximately 1 year between the different film pairs. Pair 1: 1 year before P, Pair 2: at R_u, Pairs 3 and 4: 1 year and/or 2 years after R_u respectively.

METHOD: Analysis of the lateral head films with respect to vertical maxillary and mandibular dentoalveolar growth during the periods 1 year, and 2 years after R_u.
RESULTS: Vertical dentoalveolar maxillary growth 0.5 mm during the first year after R_u was seen in 29 per cent (8/28) of the males and in 36 per cent (8/22) of the females; during the second year after R_u in 50 per cent (6/12) of the males but in no female. Corresponding growth in the mandible during the first year after R_u was seen in 36 per cent (10/28) of the males and in 32 per cent (7/22) of the females; during the second year after R_u in 42 per cent (5/12) of the males and in 25 per cent (3/12) of the females.
CONCLUSION: Especially in males the R_u skeletal maturity stage is unreliable as an indicator for vertical dentoalveolar growth completion. Thus, the placement of tooth implants should be postponed for several years after R_u.

179 A NUCLEAR MAGNETIC RESONANCE STUDY OF TEMPOROMANDIBULAR CHANGES FOLLOWING FUNCTIONAL ORTHOPAEDIC TREATMENT USING THE WÜRZBURG APPROACH

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AIM: During treatment with functional appliances a construction bite is taken so that the mandible is postured to the desired therapeutic position towards the maxilla in the sagittal and transversal direction. Thus the condylar-disc relationship is altered in such a way, that the condyles move from their central position in the mandibular fossa ventrally in the direction of the articular tuberculum. The aim of this study was to examine the relationship between the fossa, articular disc and condyle after bite correction with functional appliances.
SUBJECTS AND METHOD: As part of a major prospective multi-group study, treatment progress is demonstrated comparing the lateral cephalograms (ANB angle) and study casts (overjet, occlusion) obtained at the beginning and end of active treatment. Nuclear magnetic resonance (NMR) tomograms of the joints were obtained to examine the condylar and disc position relative to the fossa following bite correction. The study sample comprised 30 patients showing Angle Class II or Class II division 1 malocclusions with a distal occlusion exceeding ½ premolar width; the age at the onset of treatment averaged 11.6 ± 0.5 years. The treatment consisted of a Bionator in combination with extra-oral traction and up-and-down elastics. The extra-oral anterior traction kept the bimaxillary device to the maxilla. Moreover, the mandible must not be allowed to move out of the therapeutic position. The combination of the device with up-and-down elastics allowed maintenance of the mandible in the therapeutic position (bite position) during sleep, thus preventing the drop-out from bimaxillary appliance wear during the night and guaranteeing the adaptation of the muscles and articular structures. A splint (bite plane) was used for deprogramming the occlusion for 2 weeks to monitor the stability of the corrected position of the mandible.
CONCLUSION: The NMR images obtained after bite correction show that there is a regular and physiological relationship between the fossa, articular disc and condyle. Thus, the intended remodelling and adaptation of the articular structures was confirmed.

180 DISTINGUISHING POST-ORTHODONTIC DEMINERALIZED WHITE ENAMEL SPOTS FROM DEVELOPMENTAL WHITE OPACITIES BY LUMINANCE PROFILE ANALYSIS

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AIM: To develop aspects of computerized image processing for the measurement of various types of acquired and developmental white enamel lesions.
MATERIAL: Analogue (photographic) images of the anterior teeth of 30 pre-orthodontic and 30 post-orthodontic patients.
METHOD: Images were collected of affected dentitions and analysed with image analysis software using area, linear and grey level (luminance intensity) measurements. Line profile analysis of luminance was used and this enabled the collection of grey scale values along a defined line.
RESULTS: Measurements of 30 demineralized white enamel lesions from post-orthodontic patients gave a mean area of 2.06 mm^2 (SD ± 3.93), mean longest axis of 2.56 mm (SD ± 1.15) and mean width of 1.37 mm (SD ± 0.78). In comparison, 30 developmental white enamel opacities from untreated patients showed a mean area of 5.41 mm^2 (SD ± 5.34), longest axis of 3.42 mm (SD ± 1.56) and width of 2.19 mm (SD ± 0.85). Line profile analysis of luminance measured in grey levels showed a plateau effect for developmental white opacities, whereas demineralized white lesions showed a rising peak effect.
CONCLUSION: These findings demonstrate differences between developmental white opacities and post-orthodontic demineralized white lesions. The technique can be developed further to enhance this discrimination.

181 BONE INDUCTION OF DEMINERALIZATION OF INTRAMEMBRANOUS AND ENDOCHONDRAL BONE MATRICES

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AIM: To determine the route of entry of cells involved in the healing of demineralized bone matrix (DEM) prepared from intramembranous bone (DBM_{IM}) and endochondral bone (DBM_{EC}); to quantify the amount of new bone formed in DBM_{IM} and to compare it with the amount of new bone produced by DBM_{EC}.
MATERIALS: Thirty two critical size defects were created on the parietal bone of 16 adult New Zealand white rabbits.

Twelve defects were grafted with DBM_{IM} and 12 with DBM_{EC}. The remaining eight defects were used as controls. In the control group, four defects were left empty as a passive control and the other four were grafted with rabbit skin collagen as a positive control.
METHOD: Tissues were harvested for histological and ultrastructural identification on days 7 and 14. The amount of new bone formation was quantified by image analysis on day 14.
RESULTS: In DBM_{IM} no cartilage cells were identified; whereas both osteoblasts and chondroblasts co-existed in DBM_{EC}. Quantitative analysis showed 189 per cent more new bone formed in DBM_{IM} when compared with the DBM_{EC} group ($P < 0.001$).
CONCLUSION: DBM_{IM} has a greater bone induction capacity than DBM_{EC}. DBM_{IM} induces bone healing through an osteogenic route, by-passing a cartilage intermediate stage. DBM_{IM} is a more effective graft material than DBM_{EC} when grafted into skull defects.

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182 BONE INDUCTION USING COMPOSITE INTRAMEMBRANOUS BONE GRAFTS

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AIM: To examine the healing of composite intramembranous bone grafts comprising intramembranous (IM) autogenous bone grafts mixed with demineralized intramembranous bone matrix (DBM_{IM}) and to compare it with the healing of endochondral (EC) bone alone.
MATERIALS AND METHODS: Eighteen critical size defects were created on the parietal bone of 14 New Zealand white rabbits. In the experimental groups, one defect was created on each rabbit. Five defects were grafted with IM bone and five defects with RA bone with DBM_{IM} (IM-DBM_{IM} In the control groups, two defects were created on each rabbit. Four defects were left empty (passive control) and four were grafted with rabbit skin collagen (positive control). After 14 days all rabbits were sacrificed and the defects were prepared for histological analysis. Serial sections were made across the whole defect. Quantitative image analysis was performed on 100 sections.
RESULTS: Seven hundred and eight per cent more new bone was formed in defects grafted with composite IM-DBM_{IM} than those grafted with EC bone alone ($P < 0.001$). No bone was formed across the defects in either passive or positive controls. No cartilage was found in the composite IM-DBM_{IM} bone grafts
CONCLUSIONS: Composite IM-DBM_{IM} bone grafts have extremely high osteoinductive properties with enhanced integration of IM bone on IM bone defects.

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183 MAXIMAL JUMPING OF THE MANDIBLE AND STEP-BY-STEP ADVANCEMENT IN CLASS II TREATMENT

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AIMS: To compare the effect of maximal jumping of the mandible with step-by-step advancement of the mandible.
SUBJECTS: Thirteen Southern Chinese subjects with Class II division 1 malocclusions (mean age 13.3 years) treated with a splinted headgear-Herbst appliance advancing the mandible step-by-step, and 24 subjects (mean age 13.2 years) treated with a Herbst appliance for maximal jumping of the mandible. The average treatment period was 1.1 years and 0.8 years, respectively.
METHODS: The Herbst appliance was activated step-by-step at 2 mm per 2 months until an overcorrected Class I or a Class III relationship was obtained in one group and the other group achieved an incisal edge-to-edge relationship. Lateral cephalograms were taken before and at the end of treatment. For the group treated for a longer period, the data were interpreted to the same duration as the other group. The skeletal and dental treatment effects were evaluated by assessment of the sagittal and vertical changes (Pancherz, 1982).
RESULTS: Sagittal changes: The mean changes in molar relationship were larger (2.1 mm, $P < 0.05$) in the step-by-step advancement group. The maxillary base moved backwards in the step-by-step advancement group, whereas it moved forwards in the maximal jumping group, the difference being 1.3 mm ($P < 0.001$). Vertical changes: the maxillary molars intruded in the step-by-step advancement group, whereas they were extruded in the maximal jumping group, the difference being 1.2 mm ($P < 0.001$). The mandibular plane angle reduced in the step-by-step advancement group, whereas it increased in the maximal jumping group. There were no significant differences in lower facial height and maxillary plane angle between the two groups.
CONCLUSIONS: The Herbst appliance with high pull headgear and step-by-step mandibular advancement seems to have a greater influence on maxillary jaw base position and improved control on the rotation of the mandibular plane than the Herbst appliance without headgear and maximal jumping of the mandible.

184 COATING ON THE SURFACE OF AESTHETIC ORTHODONTIC WIRES

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AIM: To evaluate the coating effect on aesthetic orthodontic wires under wet conditions.
MATERIAL: $CaO\text{-}P_2O_5\text{-}SiO_2\text{-}Al_2O_3$ (CPSA) glass 1 PMMA FRP wires and bis-GMA.
METHODS: FRP wires fabricated by hot drawing, 0.45 mm in diameter, were coated with bis-GMA to protect them

from water. They were immersed in water at a temperature of 37ºC for a maximum period of 30 days. All specimens were then examined a by 1-cycle 3-point flexural test up to 2.0 mm in deflection with a span of 14.0 mm. The uncoated specimens were used for control. To evaluate the splinter-proof of the FRP wire, the ratio of the activating load and the deactivating load at 1.0 mm in deflection (retention ratio) was calculated.
RESULTS: It was found the average thickness of the coating layer was 117 gm. The average retention ratio of the FRP wires under dry conditions was approximately 85 per cent, and for the coated FRP wires 60 per cent, while about 25 per cent in the case of uncoated ones.
CONCLUSIONS: Coating with Bis-GMA is thought to be the best procedure for FRP wires.

185 SURFACE AND MECHANICAL CHANGES IN NICKEL-TITANIUM WIRES AFTER HEAT STERILIZATION

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AIM: To investigate changes in the mechanical properties and surface topography of various nickel-titanium wires after heat sterilization for recycling.
MATERIAL: Four types of nickel-titanium orthodontic wires, including Optimalloy.
METHODS: Experimental specimens which underwent two types of heat sterilization: dry heat (180ºC, 60 minutes) and autoclave (121ºC, 15–20 psi, 30 minutes). Mechanical properties were evaluated by tensile testing with an Instron 4466 (load cell capacity 1000 kg, crosshead speed: 5 mm/min, grip distance: 40 mm, in room temperature). The surface topography of the various wires was compared with each other qualitatively using scanning electron microscopy (SEM) and quantitatively with a profilometer (non-contact type: Optical dimensional metrology centre; Intek engineering). The findings were analysed statistically with Student's *t*-tests.
RESULTS: Both methods of heat sterilization had no effect on the tensile properties of any of the nickel-titanium wires used in the experiment. Before heat sterilization, the surface smoothness was highest in Optimalloy, while NiTi was the least smoothest. Surface roughness did not change in Align and Optimalloy. NiTi showed increased surface roughness after dry heat sterilization, and surface roughness was increased after both heat sterilization methods in Sentalloy. SEM showed no changes in Align, NiTi and Optimalloy, but significant surfaces changes were identified in Sentalloy after heat sterilization.
CONCLUSION: Optimalloy had the smoothest surface before and after heat sterilization treatment. The tensile property of all nickel-titanium wires was not influenced by either method of heat sterilization, but surface roughness was increased significantly in two products. Align and Optimalloy seemed clinically acceptable after heat sterilization for recycling.

186 FACE MASK THERAPY DURING THE EARLY AND LATE MIXED DENTITION

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AIM: To determine the effectiveness of face mask therapy and to evaluate the effect of age on treatment response.
MATERIALS AND METHOD: Lateral cephalometric radiographs of 34 subjects with skeletal Class III malocclusions treated with a Delaire type face mask. The total force was 600 g and the patients were instructed to wear the appliance approximately 16 hours a day. Two groups of 17 patients were formed; an early and a late mixed dentition group. At the beginning of the treatment, the mean ages were 9 years 8 months for the early treatment group and 12 years and 6 months for the late treatment group. The average treatment time was 7 months for both groups. To differentiate orthodontic and orthopaedic effects, the tracings of lateral cephalograms before and after treatment were superimposed on Ba-N at CC, palatal plane at ANS and mandibular plane at Gn.
RESULTS: In both groups forward displacement of the maxilla and increases in ANB, Wits' appraisal, overjet, facial heights and GoMe were found to be statistically significant. Evaluation of superimposition on Ba-N at CC showed that there was a significant orthopaedic displacement of the maxillary molars and incisors. A non-significant change for maxillary molars and incisors was found by evaluation of the superimposition on the palatal plane at ANS. No significant difference was observed between the groups when comparing skeletal and dental anteroposterior changes.
CONCLUSION: The results show that face mask therapy in the late mixed dentition is as effective as in the early mixed dentition.

187 ABSENCE OF MACROPHAGES IN EARLY REACTION OF PERIODONTIUM TO MECHANICAL STIMULATION

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AIM: Macrophages occur minimally in rat periodontium in steady-state conditions. This study investigated their incidence and thus putative role in the early tissue response to mechanical stimulation.
MATERIAL AND METHODS: Elastics, 0.5 mm thick, were inserted between maxillary M1 and M2 of male rats aged 8 weeks to imitate orthodontic tooth movement. Subsequently these were killed in groups of 6–7 animals together with equal numbers of unstimulated control animals at times ranging from 1–168 hours, molars with investing tissue were dissected, embedded in plastic and three 2.5 µm mesio-distal sections from each animal stained for non-specific esterase (NSE) and counterstained with Mayer's haemalum. Presence of macrophages, which typically are NSE-positive, was

assessed microscopically by determining the percentage of NSE-positive cells within the resident cell population in standard size measurement areas in periodontium distal to M2 and mesial to M3. These were sited in the middle third of the gingival papilla, immediately coronal to the interdental bone crest and in the subcrestal and mid-third apico-coronal levels of periodontal ligament subjected to histologically evident compression and tension. The results were tested for statistical significance using two-way ANOVA.
RESULTS: Extremely low numbers of NSE-positive cells were found in the measurement areas of both stimulated and control animals ranging from 0.0 to 0.2 per cent of all resident cells. Comparison of the percentage of NSE-positive cells calculated for all measurement areas assessed over the entire stimulation period in experimental animals with the values obtained from the corresponding controls showed no statistically significant differences.
CONCLUSIONS: It appears from the results obtained that the numbers of macrophages populating rat periodontal ligament and body of gingival papilla under physiological steady-state conditions are very low. Absence of an increase in macrophage numbers observed under the conditions of the present study in mechanically stressed periodontium over the period of 7 days questions the role of these cells in the early events of tissue remodelling incident to orthodontic tooth movement.

188 DIFFERENT THERAPIES IN CLASS III MALOCCLUSIONS: DECISION ELEMENTS

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AIM: Analysis of the obtained outcomes following orthopaedic, orthodontic, and surgical-orthodontic treatment of subjects with Class III malocclusions.
SUBJECTS AND METHOD: Sixty four subjects with a Class III malocclusion were grouped into three categories according to the therapy used, and the cephalometric tracings were compared. The following analyses were used: the classic analysis of Cohen, with the presence of SN as a reference plane. Steiner's analysis (modified by Root) adding the angle AB/SN plane and Delaire's analysis. All analyses were carried out pre- and post-treatment.
RESULTS: Facial depth: there were clear variations for BaS, AaA, GoPo, BoPo and ArPo. The interior points to Cohen's construction determined on SN smaller segments than those obtained by the projection of NaBa and all the exterior points to Cohen's construction. Posterior to S determined SN segments smaller than those obtained on the projection of NaBa. The activity of every segment at the facial depth in comparison with the reference line SN was evidenced by establishing larger reports while the projected segments were smaller (BaA, GoPo, BaPo). Concerning the relative activity of every segment to the facial depth, the comparison was carried out according to the Frankfort and of SN planes: the participation of middle face depth was increased for BaS (7.2 per cent for 5.1 per cent according to Frankfort's plane) and diminished for SRm (3.2 per cent for 4.2 per cent according to Frankfort's plane). Participation of lower facial depth was diminished for ArGo (0.7 per cent for 2.2 per cent according to Frankfort's plane) and for ArPo (17.3 per cent for 18.6 per cent according to Frankfort's plane).
CONCLUSIONS: There are significant variations of amplitude between the analyses according to the two reference planes. Because points S and N are easy to identify, the replacement of Cohen's plane with SN is useful in studying facial depth. Between Steiner and Cohen's analyses there is an obvious harmony, they can complement each other in a visible way.

(The following abstract was omitted from those published previously. It was presented as a poster at the 74th Congress of the European Orthodontic Society)

189 REVERSE TWIN BLOCKS FOR EARLY TREATMENT OF CLASS III MALOCCLUSIONS

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AIMS: A pilot study to establish the efficacy of reverse twin blocks in the early treatment of Class III malocclusions.
SUBJECTS AND METHODS: Eight subjects with severe Angle Class III malocclusions were included in the study. A modified version of the reverse twin block described by Clark (1995) was fitted. Lateral cephalometric radiographs were taken at the beginning and end of treatment. Each radiograph was digitized using COGSOFT version 3.6 software, superimposed on the S-N plane and changes during treatment were then assessed.
RESULTS: There were 4 male and 4 female subjects with a mean age of 10 years 3 months at the start of treatment. The appliance was well tolerated and the mean treatment time was 6.8 months. SNA increased with a mean change of 0.63 degrees and SNB decreased with a mean change of –1.6 degrees during treatment. The angle of the upper incisors to the maxillary plane increased by a mean of 4.6 degrees and that of the lower incisors to the mandible plane decreased by a mean of 5.89 degrees. The mean change in overjet was 4.8 mm, with a positive overjet achieved in 7 subjects.
CONCLUSIONS: Reverse twin blocks can be effective for early treatment of Class III malocclusions particularly for correction of reverse overjet. The results compare favourably with those using the FR III appliance (Loh and Kerr, 1985).

Clark W J (ed) Twin block functional therapy. Chapter 14. Treatment of Class III malocclusion. Mosby and White

Loh M K, Kerr W J S 1985 The Function Regulator III—Effects and indications for use. British Journal of Orthodontics 12: 153–157