ABSTRACTS

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1 PREVALENCE AND FACTORS CONTRIBUTING TO BOND FAILURE OF A NO-MIX ADHESIVE

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AIMS: To analyse the rate and significant factors for bond failures in patients treated with fixed orthodontic appliances.
SUBJECTS AND METHODS: Three hundred and twenty patients (127 boys, 193 girls, with a mean age of 14.0 years) treated with fixed appliances. Five thousand five hundred and sixty-three brackets were bonded on incisors, canines, and premolars, using a no-mix adhesive (Unite® 3M Unitek). Caries development on the labial surfaces was documented using the White Spot Lesion Index of Gorelick *et al*. (1982). The complexity of the appliance was registered on a scale from 1 to 3. Initial crowding was recorded according to a three-digit scale from intra-oral photographs. Factors evaluated were gender of the patient, complexity of the appliance, bond site location, initial crowding, and caries development.
RESULTS: The overall bond failure rate was 7.2 per cent. Bond failures were significantly higher in the lower arch, with the second lower premolar showing the highest prevalence ($P < 0.001$). There was a significant negative correlation between initial crowding and bond failure. Increases in white spot lesions during treatment and complex appliance design were significantly correlated with high bond failure rates. There were significantly higher bond failure rates in boys than in girls ($P < 0.05$).
CONCLUSIONS: (1) Crowding in the dentition was highly correlated with lower bond failures. (2) Caution should be taken in patients with higher caries activity not only to avoid the risk of developing white spot lesions, but also since this study showed higher risk of bond failures.

2 COMPARISON OF BRACKET FAILURE OF NEW VERSUS RECONDITIONED BRACKETS

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AIMS: To compare the failure rate of new brackets versus the failure rate of the same type of brackets, re-used once.
SUBJECTS: A prospective audit was performed on two groups of patients. Group 1 consisted of 106 patients who all received new brackets (Ormco Minitwin), and Group 2, 93 patients who received the same type of brackets that had been recycled once. One practitioner, always using the same bonding protocol, performed all procedures. The bonding agent was a light-cured paste (Transbond XT, 3M). All procedures were performed under normal working conditions, without any precautions, other than those normally taken in everyday clinical practice.
RESULTS: Group 1: 1894 brackets were used. The average treatment time was 19.28 months. Thirty brackets failed in 23 patients. Group 2: 1717 brackets were used. The average treatment time was 19.67 months. Eighty brackets failed in 48 patients. In Group 1, with new brackets, 21.7 per cent of the patients experienced 1.3 bracket failures during treatment, compared with 51.6 per cent in group 2 where there was an average of 1.66 failures per patient. When the number of failures was recalibrated for both groups, the number of bracket failures in group 2 would have been 91, compared with 30 in group 1.
DISCUSSION AND CONCLUSIONS: Whilst some clinical investigations have shown that reconditioned brackets have the same failure rate as new brackets, the results of this audit show that they have a failure rate that is three times higher than new brackets. The use of reconditioned brackets has now been abandoned.

3 MEASUREMENT OF TREATMENT OUTCOME WITH THE PEER ASSESSMENT RATING INDEX

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AIMS: To retrospectively evaluate and analyse treatment outcome using the Peer Assessment Rating (PAR) Index.
MATERIAL: PAR scores were performed on the pre- and end-treatment models of 65 consecutively finished cases in a three-month period. Of the 65 cases, one patient was treated with removable appliances, two had fixed appliances in one arch, 40 had fixed appliances in both arches, and 22 had a combination of removable and fixed appliances.
RESULTS: The mean PAR score at the beginning of treatment was 24.09 and at the end of treatment 3.19. The mean PAR-improvement was 86.76 per cent. Five cases were slightly improved (54–69 per cent), 47 cases were considerably improved (70–94 per cent), and 13 cases were greatly improved (95–100 per cent). None of the patients worsened or remained the same. Of the cases that improved only slightly, apart from one subject with unexpected asymmetric growth, the main reason seemed to be unfavourable myofunctional behaviour at the beginning, during, and after treatment.
DISCUSSION AND CONCLUSION: An adequate level of treatment outcome could be demonstrated by means of the PAR Index, compared with the outcome measured in other studies. Informed consent should always point out to the patients and their guardians that unexpected events, lack of co-operation, and unfavourable oral habits can influence treatment outcome. PAR scores at the end of treatment were in most cases influenced by poor intercuspation at the level of the second premolars, and small midline discrepancies. This has led to a change in finishing procedures, with more use of elastics at the end of treatment, and different positioning of brackets on the upper premolars.

4 LONGITUDINAL EVALUATION OF SOFT PALATE AND NASOPHARYNGEAL AIRWAY RELATIONSHIPS IN DIFFERENT ROTATION TYPES

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AIMS: To evaluate the relationship between soft palate and nasopharyngeal airway dimensions in different mandibular rotation types.
MATERIALS AND METHOD: A total of 72 lateral cephalograms obtained three years longitudinally from patients (mean age 10.71 ± 0.7 years) showing normal (n = 8), posterior (n = 8), and anterior (n = 8) rotation types. Soft palate and nasopharyngeal airway measurements were carried out using the Poridos computer program and the data evaluated by means of descriptive statistics and non-parametric (Mann–Whitney–U) test.
RESULTS: A linear increase in soft palate length was observed in the three groups, with the posterior mandibular rotation group showing the largest increase (28.6 ± 14.8, 35.0 ± 12.9). Soft palate length and superior nasopharyngeal space (SPAS) ratio was similar in all three groups. Non-parametric test (Mann–Whitney–U) revealed that the ANS–PNS/SPT angle was statistically significant ($P \leq 0.01$) in the posterior rotation group.
CONCLUSION: The relationship between velum and nasopharyngeal space was found to be more significant in the posterior mandibular rotation cases compared with normal and anterior rotation groups. The ratio between SPT/SPAS, which is important in velopharyngeal closure as well as speech quality was found unchanged in the three groups, which consisted of individuals showing different quantities of velopharyngeal growth without any misarticulation.

5 INTRA-ORAL MOLAR DISTALIZATION WITH NiTi COIL SPRINGS

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AIMS: To investigate distal movement of the maxillary first molars using a NiTi-coil spring and to evaluate anchorage loss measured at the upper incisor and premolar teeth.
SUBJECTS AND METHODS: Eight patients (mean age 12.4 years) with a Class II molar relationship, deep overbite, and moderate maxillary arch length deficiency. All patients had left and right first molars banded and maxillary central incisors and first premolars bonded with 0.018-inch slot Roth system brackets. Stainless steel, 0.016-inch, sectional archwires were placed between the first molars and premolars on each side and compression NiTi coil springs were incorporated into these arches. Coils were calibrated to 300 g on each side and reactivated every four weeks. A Nance appliance was used to achieve bite opening and to inhibit anchorage loss. Cephalometric radiographs were taken prior to treatment and immediately when the molars were positioned in an overcorrected super Class I occlusion. On the cephalometric radiographs: SNA(°), SNB(°), ANB(°), SN–GoGn(°), 11–21 to PtV (mm), 14–24 to PtV (mm), 16–26 to PtV (mm), 11–21 to ANS-PNS (°, mm), 14–24 to ANS–PNS (°, mm) and 16–26 to ANS–PNS (°, mm) were measured.
RESULTS: Statistical analysis showed that distances 14 and 24 to PtV were significantly increased and the distances 16 and 26 to PtV were significantly decreased. Thus, 11 and 21 to ANS–PNS, 14 and 24 to ANS–PNS, and 16 and 26 to ANS–PNS angles showed significant changes. Interestingly, the increase in 11 and 21 to PtV distances was minimal and the difference was not significant.
CONCLUSION: Consequent to molar distalization with NiTi coil springs, a mean of 0.69 ± 2.15 mm and 1.50 ± 1.95 mm (right, left) forward movement of the maxillary incisors occurred. These values were not statistically significant.

6 THERAPEUTIC EFFECTS OF THE FACE-FORMER®—A NEW MYOFUNCTIONAL TRAINING DEVICE

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AIMS: Dysfunctions of the lip soft tissues often lead to pathological changes in the anterior upper and lower dental arches. This study compared the influence of myofunctional muscle training on the strength of the orbicular muscle and on the normalization of its function within the lips.
SUBJECTS AND METHOD: Forty patients underwent myofunctional training with the Face-Former®, a device particularly developed for strengthening the lips. A further 20 persons were trained with conventional myofunctional exercises for three months. Twenty untrained children with dysfunctional lip soft tissues served as a control group. The vertical lip force was measured by means of the Myometer 1600, and a feather scale with a vestibular abutment served for registration of the horizontal share of the lip force.
RESULTS: It was found that particularly the horizontal force vector of the lip muscles was strengthened. The Face-Former® proved to be more effective than conventional training methods. An additional evaluation of photographs demonstrated a complete relaxation of the chin muscles after therapy, which previously had to be applied to achieve an adequate function under load. The Face-Former® was regarded by the patients as a comfortable device that did not cause difficulties during training.
CONCLUSION: Therapy with the Face-Former® is an effective new approach to strengthen lip muscles. It is indicated as a myofunctional support within multi-disciplinary treatment of lip dysfunctions.

7 CEPHALOMETRIC COMPARISON BETWEEN DIFFERENT SEVERITY GROUPS WITH OBSTRUCTIVE SLEEP APNOEA

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AIM: To determine whether morphological differences exist in patients with mild and moderate-to-severe obstructive sleep apnoea (OSA).
SUBJECTS: Sixty-one Chinese males divided into two groups: (a) 25 mild OSA (mean age 40.8 years) and (b) 36 moderate-to-severe OSA (mean age 44.9 years).
METHODS: The severity was previously determined by polysomnography, using the Respiratory Disturbance Index. Standardized lateral cephalometric radiographs in natural head posture were taken by one operator. The radiographs were then traced and digitized. Fifty-one variables were analysed and statistical comparisons made between the two groups.
RESULTS: For the moderate-to-severe group, the hyoid bone was located at a lower level (hy/c3ia-rgn) when compared with the mild group ($P < 0.001$). No significant differences were found between linear and angular measurements for head posture and craniofacial form when the two groups were compared.
CONCLUSION: The suprahyoid musculature, in the moderate-to-severe OSA group, may not adequately support the hyoid and associated structures. During sleep (supine position) the problem of maintaining the spatial orientation may become more acute, and differences (soft palate length and airway dimension), which would not cause symptoms during daytime, play a greater role in airway obstruction during sleep. It is suggested that the hyoid bone position may be an indicator of the severity of OSA.

8 RELATIONSHIP BETWEEN ARCH FORM CHANGE AND MOLAR POSITIONAL CHANGE WITH LIP BUMPER TREATMENT

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AIM: To investigate the relationship between mandibular arch form change and first molar positional change caused by passive expansion with a lip bumper.
SUBJECTS: Twenty-one children (13 females, 8 males, 13 ± 5 years of age) in the late mixed and early permanent dentition (Dental stage III B–III C).
METHODS: All subjects were treated with a lip bumper in order to develop the lower arch without extractions. Mandibular dental casts were obtained before and after lip bumper treatment (treatment time 14 ± 5.2 months). Following scanning of the occlusal view of the dental cast by a flatbed scanner and digitizing the buccal cusp tip of each tooth, arch forms were evaluated with a mathematical function, called polynomial of the fourth degree. The quadratic and quartic terms were assessed as the index of taperedness (IT) and squaredness (IS), respectively. First molar positional changes were analysed by measuring the standardized photographs taken from occlusal and posterior views, i.e. changes of intermolar inclination angle (IMI) and intermolar rotation angle (IMR) during treatment. Relationships between the indices of arch form and first molar position were analysed with each other statistically by correlation analysis.
RESULTS: IMI and IMR showed statistically significant correlations with IS ($P < 0.05$). IT did not show any significant correlations. The results indicate that passive expansion by lip bumper treatment correlates with distal rotation and buccal uprighting of the first molar.

9 EARLY ADULT CHANGES IN CRANIOFACIAL MORPHOLOGY—A LONGITUDINAL STUDY

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AIM: To evaluate changes in craniofacial morphology in young adults.
MATERIAL: Sixty lateral cephalometric films and dental casts from 30 individuals (14 girls, 16 boys) were evaluated. The mean age was 22.21 years for girls and 22.25 years for boys at the beginning of the observation period and 32.33 and 31.94 years, respectively, at the end of the observation period. The observation period was approximately 10 years.
METHODS: Lateral cephalometric films taken in the natural head position were analysed by the structure-based method of superimposing serial films. Measurements of the dental casts were made using a digital calliper. All tracings were digitized and changes in the cephalometric and dental cast measurements were evaluated statistically.
RESULTS: The largest changes were found in the vertical dimension. Most of the linear dimensional changes were similar in the two genders. Anterior face height increased in both sexes but the change was more pronounced in girls. Overbite increased only in girls, while postural parameters increased in boys. Soft tissue changes reflected those of skeletal changes. From the dental cast measurements, lower arch crowding increased and all arch width measurements decreased.
CONCLUSION: Early adult changes were found in all of the craniofacial parameters and these were more significant at the dental arch level during the 10-year observation period. Recognition of these factors may improve understanding of post-retention changes, which frequently occur after orthodontic treatment.

10 COMPLEX TREATMENT OF PATIENTS WITH DEFECTS AND DEFORMITIES OF THE DENTAL ARCHES

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AIMS: To determine the means and methods for early orthodontic and prosthetic treatment of children and adolescents with congenital and acquired jaw defects and deformities.

SUBJECTS: Examination and treatment of 340 children and adolescents with congenital and acquired jaw defects and deformities from 1 to 18 years of age, carried out over a period of 12 years. The patients were divided into five groups according to the main symptoms of the deformities: group 1: upper retrognathia/micrognathia and lower pro/macrognathia (26 per cent); group 2: upper retrognathia/micrognathia (17 per cent); group 3: lower pro/macrognathia/macrognathia (19 per cent); group 4: upper pro/macrognathia/macrognathia and lower retrognathia (5 per cent); group 5: lower retrognathia/micrognathia (33 per cent).
METHODS AND RESULTS: After examination the following treatment plan was devised. The first stage involved was pre-surgical orthodontic and prosthetic treatment, the main aim being correction of the shape and size of the dentoalveolar arches, creating conditions for constructive occlusion during surgery. The second stage included reconstruction of anatomical form and position of the jaws with the use of surgery. One hundred and seventy-five patients required bone reconstruction surgery. Different types of transplants and implants or combinations were used in 177 operations. Distraction osteogenesis for elimination of jaw deformities was undertaken in 50 subjects and bone reconstructive operations in 115 patients. With distraction osteogenesis, lengthening of the rami (20 mm) and mandibular body (up to 22 mm on either side) were achieved. In the third stage, post-surgical orthodontic and prosthetic treatment were carried out to stabilize the results and to finally correct the interocclusive relationships for suitable prostheses.
CONCLUSION: The best results were observed in patients who had undergone complex treatment at an early age or immediately after formation of the defects.

11 ACCURACY OF VISUAL CEPHALOMETRIC LANDMARKS COMPARED WITH DIGITIZED RADIOGRAPHIC MEASUREMENT

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AIM: To assess the clinical accuracy of a number of cephalometric variables and to compare them with the actual radiographic measurements.
SUBJECTS: Thirty-five patients were assessed by four clinicians with a spectrum of clinical orthodontic experience.
METHOD: Eight angular and four linear variables were assessed by visual inspection of each patient by all clinicians. Following clinical examination, the lateral cephalograms were scanned and digitized via a computer programme.
RESULTS: There was a statistically significant difference between the visual and digitized values for all operators. Although there was no significant difference for visual assessment between operators, there was a trend towards greater accuracy for more experienced clinicians. There was a significant difference between visual and digitized points used to assess skeletal discrepancy for all operators.
CONCLUSIONS: Cephalometric radiography remains an essential adjunct to clinical assessment for the trainee and the experienced clinician alike.

12 LANGUAGE DISORDERS ASSOCIATED WITH DENTAL MALOCCLUSION IN GROWING SUBJECTS

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AIM: To evaluate the presence of language disorders in growing subjects.
SUBJECTS: Forty subjects (20 males, 20 females) aged from 7.5 to 11.4 years were selected according to Italian nationality, time of dentition, and presence of language disorders.
METHODS: A clinical, functional, and phonetic examination was performed for each patient by two examiners. Diagnostic consistency evaluated by kappa-test was good ($\kappa > 0.80$), with kappa values for inter- and intra-examiner calibration ranging between 0.79 and 0.86. The percentage of dyslalic subjects according to age, type of malocclusion, and functional disorders was evaluated and their correlation estimated.
RESULTS: The incidence of language disorders was higher in subjects under 9 years of age. Among different forms of dyslalia, the tongue-palatal sounds were more common (95 per cent; 38 subjects), followed by tongue-dental (52.5 per cent; 21 subjects), bilabial (40 per cent; 16 subjects), labiodental (30 per cent; 12 subjects), and velar sounds (17.5 per cent; 7 subjects). No significant differences were found with respect to dental relationships but there were significant differences with respect to functional variables.
CONCLUSIONS: Malocclusion may predispose patients to the onset of dyslalia, although not all subjects with malocclusion are also affected by language disorders. The diagnosis and treatment of such disturbances may have a significant effect on the psycho-emotive development of young patients.

13 IDENTIFICATION OF ACTIVATOR PROTEIN 1 (AP-1) AS AN IMMEDIATE EFFECTOR IN THE RESPONSE OF HUMAN PERIODONTAL LIGAMENT OSTEOBLAST-LIKE CELLS TO MECHANICAL STIMULI

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AIMS: To unravel the biochemical events involved in the conversion of mechanical loading to biological outcome, in terms of cellular parameters correlating known signalling cascades to the initial phase of osteoblast-specific transcriptional control.

MATERIALS AND METHODS: Human periodontal ligament osteoblastic cells (hPDL) were subjected to static loading for various time intervals in the presence or absence of protein kinase inhibitors, and total lysates were prepared for western blot analysis. The data were evaluated densitometrically.
RESULTS: A rapid increase in the abundance of the immediate-early gene products c-fos and c-Jun [activator protein 1, (AP-1)] was apparent. The increased protein levels were paralleled by hyperphosphorylation. Pre-incubation of the cells with various protein kinase inhibitors (i.e. 5B 203580 for MAPK, PD 098059 for MEK, Y-27632 for RhoK) abolished the inductive effects, pointing to AP-1 as the pivotal downstream effector in the early response of hPDL to mechanical stimulation.
CONCLUSION: This study provides insights into the molecular mechanism governing the early stages of mechanotransduction in stretched hPDL osteoblastic cells.

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14 LONG-TERM NASAL PROFILE CHANGES FOLLOWING LE FORT I OSTEOTOMY—A RETROSPECTIVE CEPHALOMETRIC STUDY

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AIMS: Changes in the nasolabial angle have often been reported as a side-effect of a Le Fort I osteotomy. This conclusion is often based on the evaluation of a small group of cases. Moreover, it remains questionable whether the nasolabial angle can be considered as a good parameter to describe the complexity of changes in the nasal outline induced by surgery. The aims of this study were: (1) to measure the long-term changes of the nasal profile that occur after superior and/or anterior maxillary repositioning; and (2) to test the coherence between the planned surgery and the actual performed skeletal repositioning.
MATERIAL AND METHOD: Lateral cephalograms of 100 advancement/impaction adult cases treated with conventional Le Fort I-type osteotomies were analysed digitally before surgery and at three different time points after surgery. Soft tissue analysis of the nasal profile was carried out using three angular and two linear measurements, which are routinely used in the analysis performed for rhinoplasty. The data were statistically evaluated.
RESULTS: Duplo-measurements showed a reliable method. No significant correlation was found long-term between the amount of impaction or advancement of the upper arch and the five parameters considered. Except for nasolabial angle, surgery had an obvious effect on all the parameters, after which the nose-profile characteristics seem to evolve towards their original values with time. The main relapse was observed during the first six months, but there were still small changes noticeable one year after surgery. Only changes in the cant of the palatal plane seem to be associated with changes in the nasolabial angle. The predictive value of planned surgery for the effective skeletal outcome was weak.
CONCLUSION: Relapse tendencies for all parameters were clearly established. The nasolabial angle seems not to be the poorest parameter in appreciating the extent to which a Le Fort I osteotomy alters the patient's nasal morphological features. It appears that the surgical procedure is not always carried out to the extent planned in advance.

15 PRECISION, ACCURACY, AND RELIABILITY OF CEPHALOMETRIC MEASUREMENTS ON THE SKULL OF THE RAT

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AIM: One of the methods used to study craniofacial growth in humans as well as animal experimental models is radiographic cephalometry. The accuracy and precision in cephalometric studies are influenced by incorrect positioning of the subject in the cephalostat and difficulties in identification of the cephalometric landmarks. The aim of this research was to investigate some of the elements that could lead to erroneous results in radiographic cephalometry in experimental studies on rats.
MATERIAL: Twelve male rats with an average weight of 275 g were used.
METHODS: The animals were placed in the cephalostat twice, each time by a different observer, under standardized conditions. The axial radiographs were taken directly after the rats were put to death. The radiographs were digitized in a computer, 12 pairs and two single cephalometric landmarks were defined, and 14 distances were measured between them.
RESULTS: The analysis of variance showed that the intra-observer error was low. This was also the case for inter-observer measurements, except for one measurement, which was due to a possible systematic error in definition of two points. Redefinition of these points was necessary to decrease the methodological error.
CONCLUSION: Axial cephalometry of the rat is a reliable method; however, it is important that evaluation of new methods should be performed, to test and, if possible, to decrease the methodological errors before the performance of any experimental study.

16 MECHANISM OF OVERJET CHANGE IN CLASS II DIVISION 1 DUE TO GROWTH AND FUNCTIONAL APPLIANCE TREATMENT

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AIM: To describe the mechanism of overjet change due to growth and treatment with functional appliances.
SUBJECTS: Twenty consecutive male patients with skeletal Class II malocclusions treated with a headgear-activator for 12 months.

METHODS: Cephalograms were obtained six months prior to, at the start and end of treatment, and at 24 months follow-up, and analysed (Pancherz, 1982). Treatment effects were estimated by subtracting growth from treatment changes.
RESULTS: The reduction of the overjet over the total observation period was 4.9 mm ($P < 0.001$), jaw base relationship improved by 5.3 mm ($P < 0.001$), and both maxillary and mandibular incisors uprighted. During 12 months of treatment the overjet was reduced 3.5 mm ($P < 0.001$), jaw base improved by 2.7 mm ($P < 0.001$), the maxillary incisors were retracted, but the mandibular incisors were unchanged. The treatment effects were: overjet reduction (2.9 mm; $P < 0.001$); improvement of jaw base relationship (–1.5 mm; $P < 0.05$) due to a restraint of maxillary growth (–1.1 mm; $P < 0.05$), and insignificant increase in forward growth of the mandible; dental effects (–1.5 mm; $P < 0.05$) were due to retrusion of the maxillary and protrusion of the mandibular incisors.
CONCLUSION: The overjet decreased before, during, and after treatment with a headgear-activator. Sixty per cent of the total decrease in overjet was due to treatment. Overjet change during normal growth was due to improvement of jaw relationship only. During treatment the overjet was reduced because of the enhanced improvement in jaw relationship, due to restraint of maxillary growth, while mandibular growth was unaffected and the dental changes were favourable.

17 THE PREVALENCE OF MALOCCLUSION IN 12–14-YEAR-OLD SCHOOL CHILDREN IN VARAMIN, IRAN IN THE YEAR 2000

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AIM: To evaluate the prevalence of different types of malocclusion in the study group.
SUBJECTS: Five hundred and sixty-four school children (309 boys, 255 girls) between 12 and 14 years of age.
METHODS: After random selection of 564 school children and omitting those who had undergone orthodontic treatment, the remainder were examined in the centric occlusion and centric relation positions. The type of occlusion, molar, and canine relationship, overjet, overbite, and other dentofacial anomalies were recorded and the frequencies of the variables were evaluated.
RESULTS: The relative percentage frequency of the variables were: Angle classification: normal occlusion 6.2; Class I malocclusion 64.5; Class II 21.2; Class III 8.1. WHO classification: grade 0 6.2; grade 1 81.3; grade 2 12.5. Crowding 17; spacing 5.2; mandibular deviation 4.5; facial asymmetry 2.1; tongue thrust 4.6; finger sucking 4.1; mouth breathing 2.6; median diastema 1.9.
CONCLUSION: These results are different from the studies of other communities. This may be due to differences in sample size, sampling method, criteria and method of examination, age, and race.

18 PROPERTIES OF ORTHODONTIC WIRES USED IN THE BEGG AND TIP-EDGE TECHNIQUES

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AIMS: Assessment of the properties of stainless steel orthodontic wires used in the three treatment phases of the Begg and Tip-Edge techniques. The products of two manufacturers were compared.
MATERIAL: The following coiled and straight wires (0.016, 0.018, 0.020, and 0.022-inch diameter) were analysed: Bow-Flex Wire (coil) and TP Original Wire premier plus (straight and coil), TP Orthodontics; and Australian Wire special plus (straight and coil), A J Wilcock.
METHODS: In repeated experiments, the wires were examined with respect to the following characteristics: (1) diameter, (2) surface structure, (3) maximum bending stress, (4) stiffness, (5) tensile strength, (6) elastic modulus, and (7) relaxation.
RESULTS: (1) The diameters of all investigated wires corresponded to the dimensions stated by the manufacturers. (2) The surface structure of the Australian Wire special plus was rougher and darker than the other two wire types. (3) The maximum bending stress of the three wire types was comparable. (4) In every dimension the Australian Wire special plus coil had the highest degree of stiffness. (5) Except for the 0.016-inch wires, the Australian Wire special plus coil exhibited the highest tensile strength. (6 and 7) In all dimensions the Australian Wire special plus coil showed the highest elastic modulus and the lowest relaxation. Straight wires always had a lower degree of stiffness and elastic modulus than the corresponding coil wires.
CONCLUSION: For treatment phase I of the Begg and Tip-Edge techniques, the 0.016-inch Australian Wire special plus coil is recommended. For treatment phases II and III, coiled as well as straight 0.018, 0.020, and 0.022-inch wires of both manufacturers are suitable.

19 DISTAL MOVEMENT OF THE UPPER FIRST MOLARS WITH THE PENDULUM APPLIANCE—ADVANTAGES AND DISADVANTAGES

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AIMS: To evaluate (1) the clinical effectiveness of the Pendulum appliance in moving distally the upper first molars, (2) the side-effects of its use, and (3) stability of the achieved results.
SUBJECTS: Twenty-two patients (mean age 10.2 years).
METHODS: Lateral cephalograms were taken at the beginning of treatment and before removal of the appliance. After completion of distal movement of the molars the appliance remained in place for one month. After this period the appliance was removed and a Nance appliance was

inserted for three months. The distance of molar distalizaton was measured on the cephalograms as well as clinically. The exact angulation of the molars was calculated by means of a 6 mm vertical long stainless steel wire 0.021 × 0.025-inch placed in the horizontal slot of the molar band. Dental models were analysed with Vernier callipers before placement of the Nance appliance three months later. Paired *t*-tests were performed.
RESULTS: The cephalometric values were as follows: the first molars moved distally an average of 6.1 mm ($P < 0.001$) but with mean distal crown tipping of 16 degrees. The maxillary first premolars were moved 2.3 mm mesially ($P < 0.001$). The maxillary central incisors were proclined an average of 2.3 mm and tipped 3.2 degrees labially. Analysis of the models revealed a relapse of the first upper molars of 1.1 mm ($P < 0.01$).
CONCLUSION: The Pendulum appliance is an effective method for distalization of upper molars, but produces, in most cases, a distal tipping of the crown and a forward movement of the remaining maxillary teeth. Mesial relapse of the upper molars was also found even with the use of a Nance appliance.

20 MULTILEVEL MODELLING OF FACIAL GROWTH IN SYNDROMIC ECTODERMAL DYSPLASIA PATIENTS

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AIMS: To examine the craniofacial growth pattern of patients diagnosed with syndromic ectodermal dysplasia.
SUBJECTS: Sixty-one subjects (27 males, 34 females) with severe hypodontia (mean age 133 months) followed longitudinally and examined between one and five occasions (mean 2.66). The teeth absent (excluding third molars) ranged from 6 to 28 (mean 15.4). Lateral cephalograms taken at each visit allowed analysis of four angular and four linear measurements, together with one calculated ratio.
METHOD: The data from the longitudinal lateral skull cephalograms were analysed using a multilevel modelling technique with the MLwiN application software and the results presented numerically and graphically.
RESULTS: The data for male and female patients showed no statistical difference due to intra-group variability. Therefore the patients were pooled to provide the growth curves. The growth curves showed two specific trends. The most significant findings were a universal tendency for the individuals to undergo a change in the sagittal relationship of the jaws, becoming markedly more Class III with time ($P < 0.05$). A significant difference ($P < 0.01$) was also demonstrated in growth between anterior and posterior face heights, indicating that the subjects had a tendency to anterior growth rotation.
CONCLUSION: The dentition appears to have a significant role to play with respect to the height of the alveolus; failure of the alveolar process to develop leads to anterior growth rotation.

21 MATERIAL PARAMETERS OF THE PERIODONTAL LIGAMENT—AN EXPERIMENTAL NUMERICAL STUDY ON HUMAN, PIG, AND RAT SPECIMENS

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AIMS: To develop finite element (FE) models to calculate initial tooth displacements under orthodontic loads in different human and animal models and to determine the elastic properties of the periodontal ligament (PDL) of the different specimens.
MATERIAL: Ten non-fixed preparations of human anterior and canine teeth, five canines from mini pigs (genus Yucatan and Troll), each with surrounding bone and ligament, and seven mandibular segments of Wistar rats.
METHODS: The specimens were investigated in a three-dimensional laser-optical set-up to measure precisely force/deflection characteristics. The crowns of the teeth were loaded with forces between 0.1 N (rat), 1.0 N (human), and 3.5 N (pig). Initial tooth displacements were non-invasively measured by means of a system of three laser diodes defining a Cartesian co-ordinate system. Photographs were taken from histological cuts of the specimens, scanned, and FE models were generated semi-automatically using specialized software. The FE models were processed with the COSMOS/M 2.5 package. Variation of the elastic parameters was performed until the calculated displacements were precisely matched to the experimental curves. The means and standard deviations were calculated for human, pig, and rat specimens.
RESULTS AND DISCUSSION: Initial tooth displacement under orthodontic loads was dominated by the material parameters of the PDL. A bilinear approach, representing the non-linear behaviour of the PDL, could be fitted to the material behaviour of all preparations. Two Young's moduli separated by the ultimate strain(ε_{12}) were determined: human $E_1 = 0.07$ MPa, $E_2 = 0.33$ MPa, $\varepsilon_{12} = 7.4$ per cent; pig $E_1 = 0.05$ MPa, $E_2 = 0.22$ MPa, $\varepsilon_{12} = 7.5$ per cent; rat $E_1 = 0.04$ MPa, $E_2 = 0.13$ MPa, $\varepsilon_{12} = 12.5$ per cent. Only minor variations were found between human and pig material parameters of the PDL, while the values for the rat seem to differ significantly.

22 THREE-DIMENSIONAL VIDEO IMAGING OF TWIN-BLOCK THERAPY

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AIM: To determine the soft tissue volumetric and surface area changes brought about by Twin-Block therapy using a new three-dimensional (3D) video imaging system.
SUBJECTS: Ten children (1 male, 9 females) aged 10–14 years sequentially allocated for Twin-Block therapy for an overjet >8 mm.

METHODS: The subjects were recorded on the day of appliance issue and approximately three months later. The stereo-photogrammetric technique was developed from that described by Ayoub *et al*. (1996). The equipment consisted of two convergent 3-CD pods, each with a stereo pair of digital high resolution (1000 × 800 pixels) monochrome video-cameras, one digital high resolution colour video camera and two convergent flash projectors, with a capture time of 1/40 seconds, computer hardware for data display and specially developed software for data manipulation and analysis. The equipment was calibrated at each session by capturing an object of known dimensions. With a process of image matching, triangulation, and resection, a 3D model was built. Areas thought to undergo maximum change during Twin-Block therapy (upper and lower lip and chin area) were identified and surface area and volumetric changes calculated.
RESULTS: As expected, the major effects were in the lower arch. Due to initial software and hardware problems it would be misleading to present mean results for this series of patients.
CONCLUSIONS: After initial problems were overcome, the 3D video imaging system proved an effective, non-invasive way of demonstrating and measuring the effects of Twin-Block therapy. A larger clinical study will now be carried out to quantify the precise nature of the surface area and volumetric changes.

23 A NUMERICAL STUDY ON DEEP OVERBITE TREATMENT IN ADULTS

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AIM: To evaluate the stress induced in the dental and supporting structures by vertical orthodontic movements from deep overbite treatment in subjects with no bone loss and after reducing the alveolar height by 2, 4, 6, and 8 mm.
MATERIAL AND METHOD: Three-dimensional (3D) numerical models were developed of an upper central incisor and first molar using COSMOSM 2.5 finite elements analysis software. The hard tissues were simulated with 3D solid elements, while the periodontal ligament (PDL) was constructed from shell elements. Forces of different intensities were used in the treatment of deep overbite in order to obtain intrusion of the incisors and extrusion of the posterior teeth.
RESULTS: Bone loss caused the centre of resistance to move apically, but its relative distance to the alveolar crest decreased at the same time. Intrusion stress was concentrated in the apical area, whilst during extrusion there was mostly compression in the PDL.
CONCLUSIONS: Forces applied during orthodontic treatment should be reduced in order to maintain physiologically tolerable movements without further damage to the supporting structures.

24 A HISTOLOGICAL AND ULTRASTRUCTURAL INVESTIGATION OF NATAL TEETH

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AIM: To investigate the structure and ultrastructure of natal teeth using light and electron microscopy.
MATERIAL: Ten natal teeth of six newborn infants were investigated.
METHODS: The teeth were extracted during the first three weeks of life due to hypermobility. The samples were then sliced, decalcified, and stained with haematoxylin and eosin, APT (blue polychrome tanin) Dragan method, and PAS. The stained sections were examined by light and electron microscopy. The electron microscope samples were chromatized in order to obtain new details on enamel, dentine, pulp structures, and the inorganic content of hard tissues.
RESULTS: The enamel presented irregular superficial characteristics with hypoplastic traits interspersing between prismatic and aprismatic areas. The dentine layer was irregularly arranged and the hypoplastic dentine area was highly orthochromatic. Crown pulp metabolic activity was very high. Chromatizing ultrastructural samples provided new information on enamel and dentine inorganic content. Ultrastructural evaluation of dental hard tissues revealed pathological changes even in areas without apparent histological anomalies.
CONCLUSION: Due to their importance in general dentoalveolar growth and in developing occlusion, extraction of natal teeth should be carefully considered.

25 PATTERNS OF MAXILLARY ARCH GROWTH CHANGES IN INFANTS WITH CLEFT LIP AND PALATE

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AIM: Analysis of arch growth changes in the maxilla of infants with different types of unilateral cleft lip and palate (UCLP) within the first year of life.
SUBJECTS: Chronologically consecutive casts of the maxilla obtained at the age of one week, as well as three, six, and 12 months of 15 patients with complete (c)UCLP and 15 patients with UCLP associated with a soft tissue bridge (p). Pre-operatively, all patients were treated with passive palatal plates. A cheiloplasty was performed by the same method at six months.
METHODS: Cast surfaces were digitized two-dimensionally using a scanner and a personal computer. Subsequently, interactive identification of landmarks on the screen and computer aided determination of previously defined maxillary dimensions was performed. To visualize growth changes the digitized surfaces of all consecutive casts of the respective patients were superimposed in the canine region of the non-cleft side.

RESULTS: At birth: anterior jaw widths and alveolar cleft widths in cUCLP were larger than those in pUCLP. There were no differences in posterior arch widths or posterior jaw lengths. Anterior jaw lengths and the lengths of the alveolar crest were shorter in pUCLP. After six and after 12 months: alveolar cleft widths decreased in both cleft types. Anterior arch widths decreased in cUCLP and remained constant in pUCLP. In both groups there were no changes in anterior arch lengths. Increases in jaw lengths were larger in cUCLP and were caused by an increase of posterior jaw lengths and the lengths of the alveolar crest exceeding pUCLP by up to 50 per cent.
CONCLUSION: Maxillary alveolar arch growth changes were affected not only by exogenic but also by endogenic factors.

26 DISCREPANCIES OF GAP WIDTH AND TOOTH SIZE IN SUBJECTS WITH APLASIA OF THE LATERAL INCISOR

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AIMS: To measure, compare, and statistically evaluate tooth sizes in subjects with and without aplasia.
SUBJECTS: Twenty-eight patients with aplasia of both lateral incisors with a Class I occlusion and overjet and overbite between 2 and 3 mm. The control group comprised 32 patients without missing teeth. All patients were in retention or in the post-treatment phase.
METHODS: Measurements were performed with digital callipers on dental casts by two different orthodontists.
RESULTS: In the group with missing laterals, the spaces were up to 51 per cent larger than the harmonious ratio, which should be three-quarters of the mesio-distal width of the central incisors. It also became obvious that smaller dimensions of the mesio-distal diameters of centrals (–0.4 mm), canines (–0.8 mm), and first premolars (–0.7 mm) in subjects with missing upper laterals were significant in comparison with the control group and the sizes published by Moyers. No significant differences were found for the second premolars or molars.
CONCLUSION: Aplasia of lateral incisors results in prosthodontic difficulties due to the excess of space. In order to achieve harmony in the anterior segment the centrals and canines may be enlarged with composites or veneers before planning and designing the crown shapes for prosthodontic space closure of the missing laterals.

27 ANALYSIS OF A NEW BRACKET BASE FOR BONDING MAGNETS TO ENAMEL

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AIM: To determine the tensile bond strength of stainless steel magnet casings, with three types of base, to composite.
MATERIAL: Twelve neodymium iron boron magnets were encased in stainless steel. Four had blank bases, four had undercut stainless steel discs welded, and four had laser-etched bases.
METHODS: A template was manufactured using a two-part silicone model duplicating material. This was used to produce 12 blocks of composite of standardized dimensions. Each block was built up in layers and light-cured for a total of two minutes with a 460 nm wavelength (blue) curing light. Each stainless steel casing was bonded to a composite block and light cured for 40 seconds. The composite block was placed in the lower jaw of a Hounsfield H25K Universal Testing Machine with the magnet casing pointing upwards. The casing was then gripped by the opposing jaw of the machine. To test the tensile bond strength, the testing machine was set to pull at 0.1 mm/minute. The force required to pull the casing from the composite block was recorded for each of the bases in Newtons. A pair of digital callipers was then used to measure the area of each base in mm^2. The tensile bond strength was calculated in MPa. Statistical analysis (ANOVA) was performed.
RESULTS: The mean tensile bond strengths were 8.79 MPa for the blank bases, 9.01 MPa for the welded discs, and 11.58 MPa for the laser etched bases. The difference between the blank and laser-etched bases was statistically significant.
CONCLUSION: All the bases would appear to have sufficient bond strength for clinical use (Reynolds, 1975). The laser-etched base gave the highest bond strength.

28 THE FRICTIONAL COEFFICIENTS OF TITANIUM MOLYBDENUM ARCHWIRES

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AIMS: This *in vitro* study compared both the static and kinetic frictional resistance of eight archwires of different alloy composition.
MATERIALS: A single 0.022 × 0.028-inch standard edgewise stainless steel bracket was used. The archwires evaluated were 0.019 × 0.025-inch manufactured from the following: Beta titanium (TMA); 'low friction' coloured Beta titanium alloys (aqua, honeydew, purple and, violet); ion implanted Beta titanium alloy; Timolium alloy and a stainless steel control.
METHODS: An Instron universal testing machine evaluated frictional force. All experiments were carried out without ligation in the dry state with 20 degrees of torque between the archwire and bracket.
RESULTS: Static friction and kinetic friction differences were statistically significant ($P < 0.001$) for all archwire types. They were ranked as follows: stainless steel: static (1.8 ± 0.13 N) and kinetic (1.7 ± 0.08 N) friction; honeydew (3 ± 0.11 N and 3 ± 0.03 N) and ion implanted TMA (3.14 ± 0.08 N and 3 ± 0.11 N). Aqua (6.48 ± 0.14 N and 6.08 ± 0.19 N), purple (6.26 ± 0.18 N and 5.70 ± 0.07 N)

and violet (5.94 ± 0.2 N and 5.62 ± 0.13 N) produced frictional force values as high as standard TMA (6.16 ± 0.16 N and 5.50 ± 0.32 N). Timolium (4.64 ± 0.18 N and 5.02 ± 0.12 N) produced frictional forces between these and the lower frictional force archwires. The percentage difference between the archwire and bracket slot dimensions claimed by the manufacturers and those measured in this experiment produced tolerances ranging from +5.37 to –6.67 per cent.
CONCLUSION: The composition of the archwire upon which sliding mechanics is performed has relevance to the friction developed, and hence the rate of tooth movement.

29 ULTRASONOGRAPHY OF MASSETER MUSCLE THICKNESS OF ADULT KOREANS IN RELATION TO MAXILLOFACIAL MORPHOLOGY

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AIMS: To assess the thickness of the masseter muscle and its correlation with the maxillofacial skeleton.
SUBJECTS: Thirty-five male and 15 female dental students at Kangnung National University (mean age 25.8 years) with no history of orthodontic treatment, no asymmetry demonstrated on a postero-anterior cephalometric radiograph, and no temporomandibular joint problems.
METHODS: The masseter muscle thickness of the subjects was measured by ultrasonographic scanning with a 7.5 MHz linear probe, and their maxillofacial morphology was investigated by lateral cephalometric radiographs.
RESULTS: The average thickness of the male masseter muscle was 13.8 ± 1.7l mm in the relaxed state, and 14.8 ± 1.77 mm at maximal clenching, while that of females was 11.6 ± 1.58 and 12.4 ± 1.47 mm, respectively. The thickness of the masseter muscle in both sexes was increased more during maximal clenching than in the relaxed state ($P < 0.05$). The thickness of the masseter muscle during both relaxed and maximal clenching was increased more in males than in females ($P < 0.05$). In males, the thickness of the masseter muscle was negatively correlated with the mandibular plane angle, but also positively correlated with mandibular ramus height and anterior cranial base length ($P < 0.05$). No significant correlation was found between masseter muscle thickness and maxillofacial morphology in females.
CONCLUSION: Korean males with thick masseter muscles have a small facial divergence. A sexual and ethnic difference in the thickness of the masseter muscle and maxillofacial skeleton was also found.

30 DETERMINATION OF DENTAL AGE IN IRANIAN CLASS II DIVISION 1 CHILDREN

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AIMS: To determine dental age in Iranian boys and girls and its relationship to chronological age, which could assist in diagnosis, treatment planning, and the starting time of treatment for dentoalveolar disorders.
SUBJECTS AND METHOD: Three hundred and twelve patients (174 girls, average age 10 years 8 months, and 138 boys, average age 9 years 3 months) with Class II division 1 malocclusions without mandibular rotation were selected. All were in the mixed dentition without any missing or extracted teeth. Lateral cephalograms and dental pantomograms were obtained. The patients were divided into six groups of 6–12-year-old boys and girls. Growth and development of the teeth up to the second left mandibular molar were radiographically determined and divided into A to H categories and compared with those of Demirjian. The average of these figures was calculated for each patient to determine dental age. The average dental age of the six groups was determined separately for boys and girls.
RESULTS: According to the growth and development stages A to H, the average dental age in the six groups was 73.7 to 93.3 for girls and 71.5 to 92.8 for boys, which in comparison with those of Demirjian showed some meaningful differences.
DISCUSSION: The differences in the results compared with Demirjian could be due to heritage, environment, race, and nutrition. Girls are dentally advanced compared with boys.

31 INTRAVENOUS SEDATION IN ORTHODONTICS FOR CHILDREN WITH DISABILITIES

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AIM: To introduce intravenous (IV) sedation for complex orthodontic procedures in children with disabilities.
SUBJECTS: Ten consecutive patients with severe disabilities, who had previously been referred for treatment under general anaesthesia (GA).
METHODS: Sedation was achieved by IV propofol or midazolam/propofol in a continuous infusion. The following parameters were recorded: depth of sedation and the time required for induction, treatment, recovery, and discharge. The complications encountered during the procedure were assessed. The parents were polled for satisfaction.
RESULTS: Adequate operating conditions were achieved in all patients. Mean induction and recovery time were 26 seconds and 8 minutes, respectively. Mean discharge time was one hour. Complications included fear of insertion of the intravenous canula (overcome by midazolam); increased aspiration risk (avoided with rubber dam, indirect bonding technique and/or oropharyngeal pack); head and limb movements (eliminated by deepening the sedation); isolated post-operative dizziness, headaches, fatigue, feeling of cold, delayed recovery (more than 10 minutes), and mild, temporary behavioural changes. Because of the amnesic properties of the propofol, post-operative experience was excellent, which was reflected in high parental satisfaction.

CONCLUSION: IV sedation significantly reduces the use of GA and has made treatment more readily available to a larger number of disabled patients. The enrolment rate of patients has consequently significantly increased due to the ability to perform treatment in the orthodontic clinic.

32 TEMPORAL PATTERN OF BONE FORMATION DURING FORWARD MANDIBULAR POSITIONING IN THE RAT

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AIM: To quantitatively assess the amount of bone produced in the temporomandibular joint (TMJ) in response to forward mandibular positioning.
MATERIALS AND METHODS: One hundred and thirty-five female 35-day-old Sprague–Dawley rats randomly divided into seven experimental groups (10 rats each) and seven control groups (5 rats each). In the experimental groups functional appliances kept the mandible in a continuous forward position. The rats were sacrificed at 3, 7, 14, 21, 30, 37, 44, 51, and 60 days. Sections were cut through the TMJ at the sagittal plane and stained with PAS for evaluation of bone formation, and haematoxylin and eosin for observation of cellular response.
RESULTS: In the condyle, bone formation in the experimental group reached a peak at day 30. In the glenoid fossa, the experimental group reached a peak at day 21, with changes occurring mainly in the posterior part of the glenoid fossa. The amount of bone formed was significantly higher in the experimental group when compared with that of control group.
CONCLUSION: Forward mandibular positioning induced more bone formation in both the condyle and the glenoid fossa compared with the control. Osteogenesis appears to occur earlier in the glenoid fossa than the condyle.

33 ORTHODONTIC CONCERN AMONG PARENTS AND PATIENTS COMPARED WITH ORTHODONTIC TREATMENT NEED

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AIMS: To evaluate the child patient's and their parents' perceptions of the children's dentition and the desire for orthodontic treatment, and to compare these findings with professionally assessed orthodontic treatment need.
SUBJECTS: Two hundred and fifty-seven children (53.3 per cent females, 46.7 per cent males, mean age 12.0 years) who were consecutively referred for orthodontic treatment.
METHOD: An orthodontist assessed the children's treatment need using the Dental Health Component of the Index of Orthodontic Treatment Need (IOTN). Separate questionnaires were answered by the child and the accompanying parent to assess satisfaction with dental appearance and desire for treatment.
RESULTS: The distribution of the IOTN grades showed that 73.3 per cent of children had a definite need, and 26.8 per cent a borderline/no need for orthodontic treatment. No sex difference was observed. Twenty-six per cent of children and 17 per cent of parents expressed no concern for the children's malocclusion. More than half of these children were in the 'definite need' category. More females expressed orthodontic concern compared with males, and parents of girls also showed more concern than parents of boys, but both were not statistically significant. There was also no significant correlation between child and parental orthodontic concern and professionally assessed treatment need.
CONCLUSION: There is a difference of opinion on orthodontic treatment need between laypersons and orthodontists. Referring dentists and orthodontists need to assess the children's and parents' commitment and desire for orthodontic treatment before deciding on the need for referral and treatment.

34 REVASCULARIZATION OF AUTOTRANSPLANTED IMMATURE AND MATURE APICOECTOMIZED TEETH—A HISTOLOGICAL STUDY

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AIMS: To assess the pulpal changes in autotransplanted immature and mature apicoectomized teeth in which the pulp tissue was removed.
MATERIAL: Twenty-eight single-rooted teeth from two beagle dogs (3 and 6 months old). Sixteen teeth had open apices and 14 completely developed roots.
METHODS: At day 0, the dogs were anaesthetized and in each dog four teeth (first premolars) were extracted, the pulpal tissues were removed from the apical side with a nerve broach, and the teeth were then transplanted to the contralateral side. As root formation of the teeth of the adult dog was complete, the experimental teeth were apicoectomized by means of a wire cutter in order to create an open apex. The transplanted teeth were fixed with a surgical suture enabling physiological mobility. The same procedure was carried out on day 9, 16, and 23, each time on four single-rooted teeth. At the end of the experiment, the dogs were sacrificed and longitudinal paraffin serial sections were made for histological investigation.
RESULTS: After 7 days two of the four immature teeth had ingrowth of new tissue over one-quarter of the length of the teeth. At observation period day 14, all four teeth had ingrowth (≥ one-quarter of the pulp chamber). At observation period day 21, more than half of the pulp chamber of all teeth was filled and after day 30 there was total ingrowth in three of the four teeth. This new tissue consisted mostly of well-organized and well-vascularized connective tissue. Some bone cells were seen but no odontoblasts were present. Further root formation of the immature teeth was observed. Ingrowth of new tissue in the apicoectomized teeth occurred to a lesser extent.

CONCLUSION: Good ingrowth of new tissue in immature autotransplanted teeth was found, which consisted mostly of connective tissue. During the observation period, ingrowth of new tissue in mature apicoectomized autotransplanted teeth was less pronounced.

35 FRICTIONAL BEHAVIOUR OF BRACKET-ARCHWIRE COMBINATIONS USING OSCILLATING MOVEMENTS WITH SMALL DISPLACEMENTS

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AIMS: To evaluate and compare the frictional behaviour of different commercially available brackets and wires in a standardized dynamic test set-up.
MATERIALS AND METHODS: A fretting test was carried out consisting of small reciprocating tangential displacements (amplitude 200 μm) as described in the pilot study of Willems *et al*. (2000). Fourteen different orthodontic wires with a cross-section of 0.017 × 0.025-inch were evaluated against the same stainless steel orthodontic bracket with a 0.018-inch slot size (Miniature Twin, 3M Unitek, Monrovia, USA). Thirteen different orthodontic brackets, 0.018-inch slot size, were tested for their frictional behaviour against the same stainless steel orthodontic wire with a cross-section of 0.017 × 0.025-inch (3M). For each evaluated material, 10 test runs of 20 cycles were carried out and each time a new bracket/wire was placed.
RESULTS: Statistical analysis with ANOVA displayed general significant differences. Using Tukey's SRT, specific significant differences were found between the frictional behaviour of both the different wires and brackets.
CONCLUSION: Knowledge of which bracket-wire combination provides lower or higher friction can help to determine which material to select for sliding mechanics or anchorage. Frictional studies can also aid in the development of brackets and wires that generate lower friction.

36 DECAY OF FORCES AND MOMENTS DELIVERED BY A MODIFIED PENDULUM APPLIANCE

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AIMS: In order to achieve bodily movement of molars the original shape of the Pendulum appliance introduced by Hilgers was modified to an M-Pendulum. The modification was two-fold: first the orientation of the Omega-shaped loop was inverted to be open distally and, in addition, the appliance was designed with removable arms. The aims of this investigation were to measure the initial forces and moments delivered by the M-Pendulum and to calculate the deactivation and reactivation force systems.
MATERIALS AND METHODS: Based on a clinical situation, five M-Pendulum springs of the same design were fabricated by one experienced clinician. The springs (0.032-inch TMA) had a total length of 23 mm and a vertical height of 8 mm. The loops were tested by means of a computer-based strain-gauge. After 45-degrees activation, the deactivation force system was measured. After 2 mm, reactivation was carried out by bending the Omega loop to exert an uprighting moment.
RESULTS: The average distalizing force measured at the molar was 140 cNmm, and the tip back moment was 482 cNmm. An intrusive force of 5 cN was found on the molar. After 2 mm of deactivation, the distalizing force decayed to 41.5 cN and the moment to 344 cNmm. After reactivation, the uprighting moment was 560 cNmm and the distalizing force was still 65 cN, resulting in a moment to force ratio of 8.6 to 1.
CONCLUSION: The M-Pendulum is an effective and reliable method for distalization of maxillary molars. Reactivation of the spring is needed in order to upright the tooth. Its major advantage is easy handling because of the removable arms, and no patient compliance.

37 PERIODONTAL HEALTH IN UNILATERAL CLEFT LIP AND PALATE PATIENTS—A SPLIT MOUTH STUDY

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AIMS: To analyse the influence of long-lasting treatment on periodontal and dental health of unilateral cleft lip and palate (UCLP) patients. Periodontal and microbial parameters were measured and compared between the cleft and contralateral region.
SUBJECTS: Seventy-five patients (51 males, 24 females) between 8 and 20 years of age with repaired UCLP participated (before $n = 31$, during $n = 31$, and after $n = 13$ orthodontic treatment).
METHODS: The *in vivo* study was set up according to a 'split mouth' design. Four sites were defined: (1) teeth adjacent to the cleft; (2) tooth erupting in the surgically repaired cleft site; (3) contralateral tooth corresponding to the tooth in the cleft; (4) contralateral teeth relative to site 1. At all sites plaque and gingivitis indices, pocket depth, attachment loss, bleeding on probing, tooth mobility (visual and periotest), radiographic bone loss, root resorption, and gingival width were screened once. Also a pooled subgingival plaque sample was taken from sites 1, 2, and 4 for microbiological analyses.
RESULTS: In general the periodontal parameters were comparable for the four sites, with a mean attachment loss of 2.9 mm at site 1; 2.9 mm at site 2; 2.4 mm at site 3, and 2.7 mm at site 4. However, five children showed dramatic bone loss, confirmed by deep pockets in sites 1 and 2. Microbial analysis showed no difference in the proportion of

aerobic and anaerobic bacteria, but there was a higher detection frequency of pathogenic species around sites 1 and 2.
CONCLUSION: Long-term treatment to correct a UCLP does necessarily affect the periodontal health of such patients.

38 INTRAPULPAL TEMPERATURE CHANGES DURING TWO DEBONDING TECHNIQUES OF CERAMIC BRACKETS

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AIMS: Since conventional mechanical debonding of ceramic brackets causes enamel damage, two alternative debonding techniques were investigated. The aims were to compare intrapulpal temperature changes during laser and electrothermal debonding (ETD) of ceramic brackets.
MATERIAL AND METHODS: The experiment was carried out on 32 extracted human premolars. Polycrystalline Al_2O_3 ceramic brackets (chemical base) were bonded to the labial surfaces of the teeth with a chemically-cured two-paste system resin. The sample was divided equally into two groups: ETD and laser debonding. Each tooth was embedded in hard stone in a plastic cylindrical tube up to the cemento–enamel junction, and lingual access to the pulp space was drilled. Each embedded tooth was clamped to a bench with a vice and a load of 2.5 Kgm was attached to the bracket during debonding procedures. For ETD, a pistol-soldering gun with a flat tip was placed at the bracket slot and intrapulpal temperatures were recorded using a K-type thermocouple of a digital thermometer inserted inside the pulp through the lingual access. Initial temperature was recorded before debonding and the final temperature, i.e. the maximum temperature reached before decline after debonding, following cessation of gun activation. A CO_2 laser system was used for debonding (continuous wave 15 W). Initial and final temperatures were also recorded for the laser group. The intrapulpal temperature rises were obtained for the primate threshold established by Zach and Cohen (1965). Statistical analyses were carried out using an IBM computer and SAS program. Prevalence cross-tabulation and Chi square tests were run to determine the prevalence of severity of intrapulpal temperature increases for ETD and laser debonding.
RESULTS: There was a significant difference ($P < 0.05$) in prevalence of severity of the intrapulpal temperature increase between the ETD and laser groups. Approximately 87.5 per cent of ceramic brackets debonded with the laser had an intrapulpal increase of < 4°C compared with only 43.7 per cent in the ETD group.
CONCLUSION: The laser debonding technique is safer than ETD regarding the primate threshold of 5.5°C for intrapulpal temperature increase.

39 CEPHALOMETRIC EVALUATION OF MAXILLARY FIRST MOLAR DISTALIZATION

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AIMS: To evaluate changes in the position of maxillary first molars, second premolars, and incisors following treatment with a maxillary first molar distalizer.
SUBJECTS: Eleven females (mean age 15.3 years) all with moderate crowding and an Angle Class I or Class II molar relationship.
METHODS: Pre-operative records were taken for all subjects. The distalizers were fabricated and bands were placed on the maxillary first molars and second premolars. Impressions were taken and working models were poured. Formative screws were soldered to the buccal sides of the first molar bands, split rings were welded to the second premolar bands and stop screws were used to maintain the distal positions of the molars after distalization. Palatal components included butterfly-shaped Nance buttons for anchorage control. Sections of 0.045-inch tube were soldered to the palatal sides of the molar bands for insertion of the butterfly component. Nickel titanium 0.010 × 0.045-inch coil springs were fully compressed between premolars and molars to balance the action of the vestibular screws and prevent molar rotation. The patients were instructed regarding activation procedures. The appliances were removed after an average distalization time of 28 days. Post-operative cephalometric radiographs were taken and linear and angular measurements were assessed to determine molar distalization, mesial premolar movement, and changes in the long axis of the teeth. Data were statistically analysed.
RESULTS: The maxillary first molars showed a mean distal movement of 4.9 mm, which was statistically significant $t = 7.45$ ($P < 0.001$). Changes in the long axis were statistically significant, indicating a tipping movement. The maxillary second premolars showed statistically significant mesial movement but no significant change in the long axis. The maxillary incisors showed no statistically significant change.
CONCLUSION: The maxillary first molar distalizer resulted in rapid maxillary molar distalization that was accompanied by mesial movement in the premolar region.

40 EFFECTS OF 0.2 PER CENT CHLORHEXIDINE GLUCONATE MOUTHWASH ON BACTERAEMIA FOLLOWING ORTHODONTIC BANDING AND DEBANDING

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AIM: To investigate the incidence of bacteraemia after orthodontic banding and debanding, following the application of 0.2 per cent chlorhexidine gluconate mouthwash.

SUBJECTS: Two groups (banding and debanding groups) each of which comprised 40 young adult patients. For banding, incoming patients were selected if they had at least one maxillary first molar without any decay or restorations adjacent to the gingival margin. For debanding, patients who had completed fixed appliance treatment with bands on first molars and direct bonding attachments on the remainder of the teeth were selected. Patients were rejected if they had taken antibiotics within the last 30 days, if they had poor oral hygiene, or if there was any risk factor for endocarditis.
METHODS: Eleven millilitres of blood was obtained with a strict aseptic technique from the antecubital vein, immediately before banding and debanding procedures. The patients then rinsed their mouths for 60 seconds with 0.2 per cent chlorhexidine gluconate mouthwash. After rinsing, banding and debanding procedures were completed and 11 ml of post-operative blood was obtained. Blood samples were examined by several microbiological testing techniques. The incidence of post-operative bacteraemia was compared with the findings of two preliminary studies in which bacteraemia had been investigated after banding and debanding, without prior application of chlorhexidine mouthwash.
RESULTS: In the banding group, bacteraemia was detected in one post-operative blood sample (2.5 per cent). In the debanding group, bacteraemia was detected in one pre- (2.5 per cent) and one post-operative blood sample (2.5 per cent). *Bacteroides oralis* (4 CFU/ml) and *Streptococcus sanguis* 1–2 (2 CFU/ml) were the isolated species.
CONCLUSION: Comparison of the 2.5 per cent post-operative bacteraemia found in both groups in the present investigation with the 7.5 per cent (banding) and 6.6 per cent (debanding) bacteraemia detected in preliminary studies without chlorhexidine application showed no statistically significant differences between the proportions.

41 CHANGES IN WIDTH, HEIGHT, AND PALATAL HEIGHT INDEX IN PRIMARY AND MIXED DENTITION SCHOOL CHILDREN IN 1997

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AIMS: To examine palatal width, height, and palatal height index changes from the primary to the mixed dentition.
SUBJECTS: Nineteen children (8 girls, 11 boys) in the primary dentition and 52 (30 girls, 22 boys) in the mixed dentition with normal occlusion without previous orthodontic treatment were selected from Hamedan schools.
METHODS: Alginate maxillary impressions were prepared for each subject and poured with orthodontic stone. Palatal height and width were then measured between the primary canine cusp tips and also between distal line angles of the second primary molars.
RESULTS: (1) Molar region. (a) Primary dentition: mean palatal height = 15.08 mm, mean palatal width = 33.55 mm, mean palatal height index = 38.90 per cent. (b) Mixed dentition: mean palatal height = 13.70 mm, mean palatal width = 44.75 mm, mean palatal height index = 33.38 per cent. (2) Canine region. (a) Primary dentition: mean palatal height = 7.77 mm, mean palatal width = 28.47 mm, mean palatal height index = 16.61 per cent. (b) Mixed dentition: mean palatal height = 4.00 mm, mean palatal width = 28.94 mm, mean palatal height index = 13.30 per cent.
CONCLUSION: The mean palatal width of the molar region was larger in boys and this parameter increased from the primary to the mixed dentition. The mean palatal width of the canine region in boys was larger than in girls, but there was no significant change from the primary to the mixed dentition. There was no significant difference in the mean palatal molar region height in boys and this decreased from the primary to the mixed dentition. The mean palatal height index for the molar region in both sexes was not significantly different, but the mean index for the canine region was larger in boys. The palatal height index for both canine and molar regions decreased from the primary to the mixed dentition.

42 CEPHALOMETRIC ASSESSMENT OF PATIENTS WITH CLEFT LIP AND PALATE

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AIM: To assess lateral cephalometric values in patients with cleft lip and palate (CLP) in 1999 in Tehran.
MATERIALS: Twenty-four lateral cephalograms from 10 unilateral cleft lip and palate patients (UCLP) aged 9.2±3.2, and 14 bilateral cleft lip and palate patients (BCLP) obtained from two medical and dental centres.
METHODS: The patients had no history of other syndromes or chromosomal abnormalities, trauma to jaws and face, palatal bone graft, or orthodontic treatment; only soft tissue repair was carried out. Angular, linear, and proportional measurements were determined twice on the lateral cephalograms. The mean and standard deviation were obtained for every measurement and compared with the cephalometric norms of Iranian people.
RESULTS: *Y*-axis angle was larger in BCLP, and N–A–Pog was less in UCLP ($P < 0.05$). Witt's appraisal was less in BCLP than UCLP (AO was positioned further forward than BO) ($P < 0.05$). Mandibular length in UCLP was less than in BCLP ($P < 0.05$). Upper incisor inclination was less in BCLP ($P < 0.01$). The upper lip was retruded with regard to Ricketts' line in UCLP ($P < 0.01$) and the retrusion was more in UCLP than BCLP. The lower lip in BCLP was protruded according to Ricketts' line ($P < 0.02$).
CONCLUSION: Since patients with CLP have their own specific facial form, their own cephalometric data should be used for diagnosis and treatment planning.

43 TONGUE MOVEMENTS IN SPEECH AND THEIR RELATIONSHIP WITH TONGUE THRUST

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AIMS: To determine tongue location and palatal movements in pronunciation of the Persian alphabet and selected words in a tongue thrust (TT) group compared with a control.
SUBJECTS: Ten subjects, 9–13 years of age, with a TT and 10 without this habit. The children were matched for age, sex, race, type, and severity of malocclusion, with no history of orthodontic treatment, surgery, or systemic diseases.
METHODS: Phonetic testing was carried out to exclude patients with speech disorders. Maxillary alginate impressions were taken and an upper removable appliance with 12 electrodes was constructed. Fine wires connected the electrodes to a specially designed electropalatovision device. The removable appliance was inserted in the upper arch and then both groups pronounced the Persian alphabet and some selected words. A marker was designed for every electrode on the device, which showed palatal tongue movements. After recording tongue movements, the location of the tongue and the quantity of the tongue contacts were compared by Student's *t*- and Chi square tests.
RESULTS: In the TT group, the tongue had more contact with the palate at six points ($P < 0.05$). In pronunciation of the alphabets, the tongue was more forward in the TT group. The quantity of tongue contacts with the palate was similar in both groups.

44 THE INTERACTION BETWEEN BENZOIC ACID DISSOLVED IN ACETONE OR POLYACRYLIC ACID AND BOVINE ENAMEL

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AIM: To compare the interaction between benzoic acid dissolved in acetone (BAA) and aqueous polyacrylic acid solutions and bovine enamel.
MATERIAL: Bovine incisors with intact enamel.
METHOD: Incisor enamel was used for scanning electron microscopy (SEM), photometric and X-ray photoelectron spectroscopic (XPS) studies. For SEM and XPS investigations enamel slabs approximately 0.8 cm^2 and 2 mm thick were used. Ground, cleaned, and dried surfaces were exposed for 2 minutes to the action of a 3 per cent solution of BAA or treated with a 25, 10, 5, or 3 per cent aqueous polyacrylic acid solution. For photometric studies, the enamel slabs were crushed in order to obtain a powder. Ten milligrams of enamel powder was then incubated with 2 ml of the above-mentioned solutions for 2 hours. After centrifugation at 28,000 g for 20 minutes the supernatants were tested for calcium (Ca) and phosphorus (P) content according to the colorimetric Calmagit and Ascorbin acid methods.
RESULTS: The photometric studies showed no release of Ca and P caused by BAA. This result was confirmed by SEM. When conditioned with aqueous solutions of polyacrylic acid, the photometric measurements revealed release of Ca and P from the enamel. The atomic ratio of released Ca/P varied with the polyacrylic acid concentration. SEM investigations of these surfaces showed unambiguous etching patterns. The XPS measurements for all investigated surfaces binding energies were 133.8 ± 0.1 eV for P_{2p}, 347.8 ± 0.1 eV for $Ca_{2p3/2}$, and 531.8 ± 0.1 eV for O_{1s}. These binding energies were typical for hydroxyapatite surfaces. Broad carbon spectra revealed a complex and variable carbon species, depending on the conditioning agent. The highest content of carboxyl-type carbon was observed on samples treated with polyacrylic acid. BAA treatment led to an increase in the intensity of the binding energy of approximately 285 eV.
CONCLUSION: The interaction between BAA and bovine enamel differs from that between polyacrylic acid and enamel.

45 BENDING PROPERTIES AND DEACTIVATION BEHAVIOUR OF SUPER ELASTIC ARCHWIRES—CONSEQUENCES FOR ORTHODONTIC THERAPY

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AIMS: To characterize commercial NiTi archwires in terms of their mechanical properties and an analysis of the superelastic plateau. The mechanical properties were investigated as function of temperature (6–60°C).
MATERIAL: Twelve NiTi arch materials from seven different suppliers, with the dimension 0.016 × 0.022-inch, were selected for the investigation.
METHOD: The mechanical bending properties were determined in a three-point bending test at 6, 22, 37, and 60°C and a testing deflection of 1.5, 2, and 2.5 mm. The superelastic plateaus were analysed by using the parameters plateau start/finish, plateau slope, the minimum deflection for stress-induced martensite (SIM), the slope at the start of unloading, and flexion modules.
RESULTS: All NiTi wires showed pronounced loading and unloading plateaus at 37°C and displayed a marked decrease in plateau forces upon unloading (hysteresis). The investigation revealed a dependence of the plateau forces on the baseline condition. The martensitic arches showed lower plateau forces than the martensitic–austenitic, austenitic archwires. In addition, a marked and virtually linear dependency of the plateau forces on the temperature was demonstrated. Compared with austenitic wires, the formation of SIM in the martensitic wires began at smaller deflections and forces. The martensitic arches with their

marked temperature-dependent behaviour still have a smaller gradient (plateau slope) in the load discharging phase.
CONCLUSION: The investigation revealed a dependence of the plateau forces on the baseline condition [martensitic (at room temperature), martensitic–austenitic, and fully austenitic] and temperature. Moderate plateau forces are only achieved with martensitic arches. These archwires also show better results for plateau start/finish/slopes and should be preferred for orthodontic treatment. In subjects with minor misalignment of the teeth, the working range of NiTi wires remains within the linear-elastic range of the unloading curve, thus no further advantages are gained compared with cold-shaped wires or steel alloys.

46 THE EFFECT OF ANABOLIC STEROIDS ON MANDIBULAR GROWTH

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AIM: To assess the effect of deca durabolin (nandrolone) on mandibular growth in growing and non-growing rats using cephalometry, radiography, and immunoradiology.
MATERIAL: Two groups of growing (n = 16) and non-growing (n = 16) inbred female Wistar-Kyoto rats were compared. Each group was divided into two subgroups with eight experimental (E) and eight control (C) animals in each subgroup.
METHOD: Metallic implants, as fixed radiographic markers, were placed in the mandibles of all rats. (1) Lateral head films from before and after an experimental period of 70 days were analysed. Furthermore, the (2) weight, (3) blood serum IGF-I, and (4) Leptin levels were monitored weekly.
RESULTS: (1) Marked mandibular growth changes occurred in both growing and non-growing E-rats. (2) Weight increase was larger in E than in C animals. (3) The IGF-I blood serum level was comparable in growing E and C rats but was increased in non-growing E animals. (4) The Leptin level was increased in both growing and non-growing E animals.
CONCLUSION: Anabolic steroids have a marked effect on mandibular growth in both growing and non-growing rats.

47 THREE-DIMENSIONAL ANALYSIS OF THE SURFACE OF ENDOSSEOUS PALATAL IMPLANTS AND BONES AFTER VERTICAL, HORIZONTAL, AND CROSSWISE APPLIED FORCES

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AIM: The effects of bite and orthodontic forces exerted on endosseous palatal implants are not completely understood, especially biomechanical properties regarding different implant geometries and resulting bone remodelling reactions on the one hand, and the influence on the direction and magnitude of the applied force on the other.
MATERIAL: Three types of endosseous implants were used. Type 1 was a simple cylindrical-shaped implant, type 2 a cylindrical-shaped implant with a superperiosteal step, and type 3 a cylindrical-shaped implant with a superperiosteal step that was subperiosteally screw-shaped.
METHODS: The load on the implant surface was investigated under three kinds of bite and orthodontic forces from 0.01 to 100 N (vertical, horizontal, and crosswise). The results were calculated by means of a finite element method using the FE package COSMOS/M 2.5 on a commercial Athlon-850 PC.
RESULTS: For type 1 implants and vertical loading, the largest strain was at the apex of the implant and the lowest strain in the compact plates. For type 2 and 3 implants changes in strain concentration from trabecular to compact bone and from apex to the neck of the implant became obvious. Additional anchorage elements on implants caused a decrease of bone strain by 30 per cent. These results were observed for all three types of force.
CONCLUSION: All investigated implants show good biomechanical properties. However, the type 3 implant showed the best biomechanical properties at low strains that resulted in less bone resorption and improved healing. The trend is to optimize the design of implants by producing small implants with additional anchorage on the bone surface.

48 CHANGES IN THE CONTENT OF CONTRACTILE PROTEINS AND METABOLIC ENZYMES IN THE MASTICATORY MUSCLES AFTER SAGITTAL MANDIBULAR ADVANCEMENT IN PIGS

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AIM: To investigate histologically and biochemically muscle composition and fibre shifting to detect myosin heavy chains (MyHC).
MATERIAL: Histochemical and electrophoretic analyses were performed on different masticatory muscles (masseter, temporal, geniohyoid, and medial pterygoid) of 10-week-old pigs after 28 days of chronic sagittal advancement of the mandible with build-ups.
METHODS: The difference between fibre type and subdivision of fast fibre population was investigated histochemically with myofibrillar ATPase (mATPase) and immunohistochemistry. Analysis of muscle changes was performed by means of immunoblot with monoclonal antibodies specific to selected MyHC isoforms. The results of both methods were compared.
RESULTS: Increase of type I fibres and type I MyHC in the anterior part of the masseter, the distal part of the temporal and the medial pterygoid muscles was measured after chronic sagittal advancement of the mandible with both methods. Clear differentiation was possible between type I

and II muscle fibres using histological analysis. Additionally, a direct correlation between the MyHC concentration and histochemical and immunohistochemical staining was seen. However, histochemical classification of fibre types can lead to misinterpretation. Thus, these data demonstrate a limitation in mATPase histochemistry. The immunoblot method using monoclonal antibodies against specific MyHC isoforms seems to be more sensitive and less subjective.
CONCLUSION: The immunoblot method used for measuring MyHC content is a valid alternative for muscle fibre typing in pigs as it is less costly, time-consuming, and more sensitive than qualitative histochemistry. The method offers new prospects for application in dental and oral surgery studies.

49 DISTAL MOVEMENT OF UPPER CANINES USING THE ZYGOMA ANCHORAGE SYSTEM

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AIM: To develop orthodontic auxiliaries to connect zygoma anchorage with the anterior teeth.
MATERIAL: The zygoma anchorage system (ZAS) was used to distalize 18 upper canines in first premolar extraction cases.
METHOD: To move upper canines a bracket (0.018×0.025-inch) with a large vertical slot was used. A rigid power arm was developed to fit in the vertical slot. The hook at the end of the power arm was situated at the level of the centre of resistance of the canine and the ball at the end of the anchor in front of the furcation of the roots of the first molar. Between the power arm on the canine and the zygoma anchorage, a nickel titanium closed coil spring of 50 or 100 grams was fixed. The direction of the force was parallel to the archwire of the fixed appliance.
RESULTS: After two to three months of orthodontic alignment, a coil spring was inserted between the anchor and the power arm. Over a 0.016-inch Australian® archwire 18 canines were moved bodily over a distance of 1 mm a month using sliding mechanics. The force system was easy to adjust and was well tolerated by the patients.
CONCLUSION: Rigid power arms on the canines in combination with nickel titanium coil springs make it possible to use orthodontic forces parallel to the occlusal plane and passing through the centre of resistance of the teeth. The ZAS can be used unilaterally or bilaterally to improve posterior anchorage.

50 Nd:YAG LASER WELDING FOR ORTHODONTIC APPLIANCES: BIOCOMPATIBILITY AND CORROSION

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AIMS: Even if orthodontic materials are used for relatively short treatment, the problem of biocompatibility, including corrosion, is as relevant in orthodontics as it is in prosthetics. The aims of this study were to compare brazing and laser welding.
MATERIAL AND METHODS: Sixty patients from whom a gingival biopsy was obtained near to the site of the laser welding and braze.
RESULTS AND CONCLUSIONS: The advantages of laser welding in constructing orthodontic appliances are: biocompatibility; no galvanic currents; no toxicity; no allergic reactions; no risk of cancer; no dental or periodontal reactions; high bond strength and corrosion resistance, since laser welding does not use solders of different metals; low thermal stress; time saving, greater precision and workability in processing than with soldering or other techniques. The ability to reproduce the laser beam assures a consistent quality in the results of the treatment.

51 EFFECTS OF THE PROTRACTION FACEMASK ON VERTICAL DIMENSIONS—A CEPHALOMETRIC STUDY

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AIM: To evaluate the skeletal responses to a maxillary protraction facemask on the vertical dimension in Class III patients.
SUBJECTS AND METHODS: Twenty patients (10 males, 10 females, mean age 8 years) with dental and skeletal Class III were analysed. All the patients were treated with a banded appliance using a facemask with protraction forces exerted by elastics for 14 to 18 hours a day. Standardized lateral cephalograms were obtained before treatment (T1), at the end of treatment (T2), and after an observation period of 1 year (T3). The vertical skeletal relationships were analysed by angular and linear cephalometric measurements (maxillary inclination SN/SNP–SNA, mandibular inclination SN/Go–Gn, vertical jaw relationship SNP–SNA/Go–Gn, posterior facial height S/Go, anterior facial height N/Me).
RESULTS: Maxillary inclination diminished between T1 and T2 and increased between T2 and T3. The mandibular inclination increased between T1 and T3 (mean 1.7°). Vertical jaw relationship increased between T1 and T2 (mean 2.4°) and diminished between T2 and T3. The posterior and anterior facial height increased 2 mm and 2–4 mm between T1 and T2, respectively).
CONCLUSIONS: Facemask therapy causes an increase in vertical facial dimensions due to a posterior rotation of the mandible and thus its use is not indicated in high angle cases.

52 RELIABILITY OF THE ROENTGENOGRAPHIC TEMPOROMANDIBULAR JOINT PROGRAMS OF THE ORTHOPHOS CD

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AIM: To analyse the reliability and validity of the special temporomandibular joint (TMJ) programs (P4, P5, P8, and

P9) of the Orthophos CD and to assess the effect of changes in skull position on the radiographic image.
MATERIAL: Six dry skulls with a complete maxillary and mandibular dentition as well as a normal appearance of the mandibular condyle and the glenoid fossa.
METHODS: The temporal component of the TMJ and the lateral, medial, and posterior poles of the condylar head were marked with metal pins. Radiographs were taken in 'ideal head position' for each of the four programs according to the manufacturers' instruction. Additionally roentgenograms were taken in anterior, posterior, and lateral inclinations of the skull as well as horizontal rotations performed gradually in 1-degree steps. The changes in condylar height and width, fossa height, joint space width, and projection of the TMJ markers were evaluated metrically and visually.
RESULTS: Neither for the condyle nor for the fossa did the radiographic images of the TMJ display the actual anatomical relationship. Changes in skull position resulted in marked image distortions especially in programs P5, P8, and P9, in which the TMJ structures in many cases were projected outside the film area. Therefore, a metric analysis using these programs was impossible. Although the program P4 was less susceptible to changes in skull position, image distortion simulated condylar flattening, joint space narrowing, and left–right condylar asymmetry.
CONCLUSION: Due to the high susceptibility to minimal changes in skull position, the radiographic TMJ programs P5, P8, and P9 of the Orthophos CD cannot be recommended for clinical use. The program P4 exhibited the same susceptibility to image distortion as regular dental pantomography and is thus of no advantage for TMJ diagnosis.

53 CRANIOFACIAL CHANGES PRODUCED BY A FACEMASK IN CHILDREN WITH UNILATERAL CLEFT LIP AND PALATE

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AIM: To compare the effects of maxillary protraction produced by a facemask in two groups of patients: one with skeletal Class III (due to maxillary retrognathism), and one with skeletal Class III combined with unilateral cleft lip and palate (UCLP).
MATERIAL AND METHOD: Lateral cephalometric radiographs of three groups of patients were studied. Group A: 19 patients with skeletal Class III with complete UCLP (mean age 8.6 years); Group B: 39 patients with skeletal Cass III, without clefts (mean age 8.4 years); Group C: 46 patients with skeletal Class III without clefts, untreated in the period investigated (mean age 8.5 years) served as the control. For each patient two cephalometric radiographs were obtained: T1 before treatment and T2 at the end of active traction. The average treatment time was 11 months. In the control group the second radiograph was obtained at the same interval. The following variables were measured: SNA, SN/SpP and SNA–SNP. A Student's *t*-test was used to compare the mean value of each parameter within the three groups investigated, and Wilcoxon's test to compare the differences between T1 and T2 among the groups.
RESULTS: During treatment SNA angle increased more in Group A than in Group B. For the same period, the mean value for SNA slightly decreased in Group C. Inclination of the maxilla was stable in Group C while in Group A it decreased significantly ($P < 0.001$). As expected, the length of maxilla increased in all three groups, but the differences between T2 and T1 were not statistically significant.
CONCLUSION: The effects of maxillary protraction produced by the facemask were more evident in patients with UCLP than in subjects with only a skeletal Class III malocclusion.

54 ORTHODONTIC UTILIZATION OF MOLECULAR-GENETIC METHODS TO DIAGNOSE CLEIDOCRANIAL DYSPLASIA

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AIM: To determine the craniofacial and dental phenotypes of patients with cleidocranial dysplasia for correlation purposes. Cleidocranial dysplasia is a rare genetic disorder causing severe disturbances in bone and dental development. Its aetiology is attributed to mutations on the CBFA1 gene. Due to its wide clinical expressivity, an unequivocal diagnosis can be difficult. With molecular genetic methods the diagnosis can be confirmed and treatment can be adjusted accordingly.
SUBJECTS: Fifteen patients with cleidocranial dysplasia were characterized clinically with respect to dental expression. The genotype was determined with the use of PCR, SSCP, and direct sequencing.
RESULTS: Numerous new mutations were found on the CBFA1 gene. Several patients had identical phenotypes but showed wide clinical expressivity, even within the same family. On the other hand, mutations on different domains led to nearly identical phenotypes.
CONCLUSION: Detailed clinical examination is necessary to detect minimally affected gene mutation carriers. The new possibility of molecular-genetic analysis for developmental disorders will result in more accurate predictions in skeletal and dental growth.

55 QUALITY OF ORTHODONTIC TREATMENT OUTCOME—IS IT A MATTER OF CERTIFIED TRAINING?

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AIM: To assess the influence of orthodontic training on the quality of treatment outcome.
SUBJECTS: One hundred and twenty-one consecutive students in the first year of dental school collected over

5 years. Seventy subjects (58 per cent) were orthodontically treated and 51 (42 per cent) were not.
METHODS: DMF(T)-Index values were recorded. Dental casts were analysed and orthodontic treatment need was assessed using the Dental Health Component of the Index of Orthodontic Treatment Need. Treatment results of general dental practitioners (GP) and certified orthodontists (OD) were compared.
RESULTS: Orthodontically treated subjects exhibited statistically significantly lower DMT(T) values than untreated individuals. The orthodontic treatment need was lower in the OD than in the GP group. Treatment performed by OD resulted in statistically significant better treatment results in terms of a higher prevalence of Class I occlusal relationship (OD 73 per cent, GP 37 per cent), normal overjet (OD 58 per cent, GP 27 per cent), and no or only minor crowding (OD 75 per cent, GP 45 per cent). For all other variables (overbite, transverse, or lateral anomalies) there was only a tendency towards better treatment results in OD-treated subjects.
CONCLUSION: Orthodontically treated individuals have a lower DMF(T) Index. Treatment performed by OD leads to improved treatment results and lower remaining treatment need compared with that of GP.

56 THE EFFECTS OF FLUORIDE RECHARGE TO DIRECT LAMINATE VENEERS FOR ORTHODONTIC TREATMENT

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AIM: It has been reported that the amount of fluoride ion released from a direct laminate veneer is constantly higher than that of direct bonded brackets using glass ionomer cement (GIC) adhesive. It is well known that GIC not only has the ability for fluoride release but also the capacity of fluoride up-take (recharge). The aims of this study were to investigate the differences in the amount of fluoride released from a recharged and non-recharged veneer.
MATERIAL: Twenty-four acrylic discs were prepared as artificial teeth. Both GIC and micro particle filled resin were laminated on the discs with a thickness of 0.3 mm.
METHODS: Recharge group: fluoride recharge (2 per cent NaF, 15 minutes) was performed four times over a 7-day interval. The first recharge was undertaken on day 7 after the start of the experiment. Fluoride measurements were carried out daily throughout the experiment. Non-recharge group: the control group did not undergo recharge. Each sample was immersed in the container with 2 ml fresh distilled water and stored at 37°C for 24 hours before every measurement.
RESULTS: (1) The highest amount of fluoride ion released from a recharged veneer was recorded 24 hours after fluoride recharge. The amount of fluoride then decreased rapidly from 24 to 48 hours after recharge and decreased slowly from 48 hours to day 7. (2) The amount of fluoride released from the recharged veneer measured just before the second recharge was significantly higher than that of the non-recharged veneer.
CONCLUSION: Fluoride recharge is an effective procedure to maintain the high amount of fluoride ion released from a GIC veneer.

57 SHEAR BOND STRENGTHS OF POLYOXYMETHYLENE BRACKETS BONDED WITH DIFFERENT ADHESIVES

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AIM: To compare bond strengths and bracket failure location of six different adhesives to determine the best bonding method for a tooth coloured polyoxymethylene bracket.
MATERIAL: Seventy freshly extracted human teeth were bonded with either polyoxymethylene brackets (Brillant®, Forestadent) or stainless steel orthodontic brackets (Ultra-minitrim, Dentaurum) using either No-Mix (Dentaurum), Quick Bond (Forestandent), Transbond (3M/Unitek), Enlight LV (Ormco), Light Bond (Reliance), Fuji Ortho LC (GC America), or 37 per cent H_3PO_4 (Dentaurum).
METHOD: Brackets were attached to the etched enamel surface by one of seven protocols: (1) Brillant and No-Mix, (2) Brillant and Quick Bond, (3) Brillant and Transbond, (4) Brillant and En-Light, (5) Brillant and Light Bond, (6) Brillant and Fuji Ortho LC, or (7) Ultra-minitrim with Transbond as the control. The specimens were stored in deionized water for 72 hours. A Zwick universal testing machine was used to determine shear bond strengths. The residual adhesive on the enamel surface was evaluated with a modified Adhesive Remnant Index (ARI). ANOVA, Duncan's, and Chi-square tests were used to compare the four groups at a rejection level of $P = 0.05$.
RESULTS: The mean SBS and SD in MPa were: Group 1 = 8.7 (4.0), Group 2 = 13.3 (3 1), Group 3 = 12.9 (3.4), Group 4 = 11.5 (11.6), Group 5 = 14.6 (1.8), Group 6 = 11.4 (3.0), Group 7 = 24.4 (5.8). Statistical analysis showed significant differences ($P < 0.001$) in bond strength between Group 7 and the rest, and between Group 1 and Groups 2, 3, and 5, but no differences in ARI scores.
CONCLUSION: All bonding methods, except Group 1, in this *in vitro* study appeared to present clinically acceptable bond strengths. Although Brillant brackets show dual retention, mechanical and etched surface of bracket base, they do not achieve the bond strengths of stainless steel brackets.

58 EXTRACELLULAR MATRIX SYNTHESIS BY MECHANICALLY STIMULATED GINGIVAL FIBROBLASTS: ESTABLISHMENT OF AN EXPERIMENTAL MODEL

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AIM: To establish and test a convenient *in vitro* experimental model for future studies of the reactions of human gingival fibroblasts to mechanical stimulation.

MATERIAL AND METHODS: Primary cultures of human gingival fibroblast-like cells were derived, routinely maintained, seeded into flexible-bottomed multiwell tissue culture plates and subjected to intermittent stretching in a FX-3000™ Flexercell Strain Unit varying frequency, magnitude, and duration of stimulation, and culture medium composition. The medium was collected and stored for evaluation of extracellular matrix (ECM) constituents collagens (COL) type I, III, and V by specific ELISAs. Cell monolayers were used for estimation of cell proliferation and apoptosis using modified assay kits based on mitochondrial dehydrogenase activity and caspase-8 activity, respectively. In preliminary work, evaluation of COL I was established by modifying a commercially available ELISA kit (Prolagen®) using C-terminal peptide as an assay marker. Double-sandwich ELISAs employing specific monoclonal primary antibodies in optimal dilutions were established for detection of COL III and V, and their detectability, sensitivity, and reproducibility were tested and calibrated empirically in precursor trials.
RESULTS: ELISAs of COL I and III performed favourably when they were applied for estimation of these ECM constituents in cell culture medium. COL V was not detected in cell culture medium under any conditions. Variation of parameters of mechanical stimulation was reflected by changes in COL I and III synthesis and proliferative activity of stimulated cells compared with unstimulated controls.
CONCLUSION: This assay system is a convenient experimental model for studies of reactions of human gingival fibroblasts to mechanical stimulation.

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59 CAN THE CONDYLAR PATH BE ASSESSED RADIOGRAPHICALLY?

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AIM: To determine whether axiographic recordings of condylar pathways during protrusive movements can be estimated radiographically.
SUBJECTS: Twenty-two adult volunteers (10 men, 12 women) between the ages of 18 and 32 years, all with a Class I molar relationship with normal occlusion were selected.
METHOD: For each individual two sets of data were obtained. First, protrusive condylar movements were recorded with SAM axiography, and the hinge axis point was tattooed on the skin. Second, a series of three standardized cephalometric radiographs were taken at three different mandibular positions: centric occlusion, end-to-end, and maximum protrusive position. The hinge axis tattoo location was transferred on the centric occlusion radiographs by radiopaque markers and this point was carried on the other two radiographs by mandibular superimposition. The tracing was superimposed on the cranial landmarks of each of the three exposures, and the three hinge axis dots were transferred to the tracing paper. Finally, protrusive condylar curvatures (represented by six dots) and the three hinge axis dots were placed on transparent millimetre graph paper and digitized. The computer was programmed to calculate the radius of a possible circle passing through the three points. Because of the six dots representing the condylar curvature, two possible radii were calculated and the average value was defined. Correlation analysis was performed.
RESULTS: The repeatability coefficient between the two methods was found to be low, r = 0.77, as well as the correlation coefficient $r^2 = 0.766$.
CONCLUSION: Although the axiographic recording procedure is complicated, radiography was not found to be an alternative for the determination of condylar movements that represent a form–function relationship.

60 SCANNING ELECTRON MICROSCOPY OBSERVATION OF INTERPROXIMAL ENAMEL SURFACES AFTER STRIPPING

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AIM: To examine the interproximal enamel surface of premolars and lower incisors after three different stripping procedures.
MATERIALS AND METHODS: Thirty-six teeth (20 lower incisors, 16 premolars) were observed with scanning electron microscopy (SEM) after interproximal enamel reduction. In the first group ($n = 9$) teeth were stripped using stainless steel separating strips. The teeth of the second group ($n = 9$) were stripped with diamond burs ultrafine grain and composite polishing discs. In the third group ($n = 9$) the procedure was carried out with multibladed carborundum burs. The fourth group ($n = 9$) was used as a control. The teeth were placed in a typodont simulating clinical conditions and observed with SEM at × 200–400 and 800. The results were statically processed.
RESULTS: It appeared that the surface roughness was different for each group. In the first group the interproximal surface was crossed by irregular ridges that were not uniformly distributed; diamond debris was found. In the second group there was a mix of smooth and rough portions, as the effect of the diamond bur and disc passage was observed. The smoothest surface was observed in the third group.
CONCLUSIONS: Enamel surfaces stripped with multibladed burs were the smoothest and least damaged.

61 UPPER LIP MOVEMENT CAUSED BY RETRACTION OF ANTERIOR TEETH

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AIM: To investigate a method for three-dimensional (3D) evaluation of hard and soft tissues both before and after modification of anterior teeth.

MATERIALS: Twenty patients during anterior tooth retraction.
METHODS: Using the Frankfort Horizontal of the subject as the standard, the head was immobilized by ear-rods and movements of the perioral soft tissues during anterior tooth retraction were measured by a non-contact 3D measuring device. The following orthogonal coordinate system was established: the plane determined by three points, the superior points of the right and left ear rod (PoR, PoL) and the left suborbital point (OrL) were used as the basic plane, and the central point of the Po (PoC) as the base point. A straight line passing through the base point and the central point between right and left Or was used as the *X*-axis, and a straight line passing through the base point and lying vertical with the base plane as the *Y*-axes. A straight line perpendicular to the *X*- and the *Y*-axes was used as the *Z*-axis. The centric position of the brackets and the proximal soft tissue points of each were used as the measurement points.
RESULTS: The relationship between the movement of the soft tissue and the anterior teeth showed a linear regression tendency in the *X* and *Y* constituents.
CONCLUSION: This method is able to project the position of the upper lip after anterior tooth retraction, and will be useful in treatment planning, including the soft tissues.

62 IS FACIAL BEAUTY MEASURABLE?

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AIM: To establish if an attractive face has 'divine proportions'.
MATERIAL: En face photographs of 50 females portrayed on the covers of well-known fashion magazines ('cover models').
METHODS: Analysis of four transverse and six vertical facial components. The actual measurements were compared with corresponding calculated ideal values ('divine proportions').
RESULTS: Transverse dimension analysis: on average, ideal transverse facial proportions were seen in 28 per cent of the 'cover models'. Smaller than ideal values were recorded in 48 per cent and larger values in 25 per cent of the subjects. Vertical measurement analysis: on average, ideal vertical facial proportions were noted in 30 per cent of models. Smaller than ideal values were registered in 42 per cent and larger values in 28 per cent of the subjects.
CONCLUSION: 'Divine facial proportions' exist in only one-third of the 50 'cover models' analysed and therefore can only partly explain facial beauty.

63 UNILATERAL CROSSBITE AND ITS INFLUENCE ON BODY POSTURE

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AIM: To verify the relationship between unilateral crossbite and body posture.
SUBJECTS: Twenty children, 5–8 years old, prior to orthodontic treatment with unilateral crossbite and a control group of 20 children with normal occlusion.
METHODS: Frontal photographs of all children prior to and after treatment, as well as their body posture while standing upright, were rated by their mothers and an orthodontist. The parents completed a questionnaire to evaluate a possible relationship with factors such as habits, genetics, allergies, or other environmental influences. The same assessments were undertaken in the control group. A certified orthopaedic therapist examined all children concerning spine, length of arms and legs, and muscle disorders. A statistical evaluation was performed to reveal correlations between both groups.
RESULTS: There was a correlation between crossbite and body posture. Nearly all patients showed a higher shoulder on the contralateral side (i.e. the non-crossbite side) as well as facial asymmetries. Compared with the control group, more children were mouth breathers or showed a habit. No difference was found with respect to breast or bottle-feeding.
CONCLUSION: Since unilateral crossbite influences body posture, it should be treated as early as possible to regain normal growth and development. A longitudinal study concerning long-term results will be necessary for further investigation of this subject.

64 INFLUENCE OF TONGUE THRUST ON THE SPATIAL AND TEMPORAL DIMENSIONS OF SPEAKING MOVEMENTS

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AIM: Malfunctions of the tongue are reported to be of major aetiological significance in the development of speech disorders and malocclusions. The aim of this study was to compare the spatial and temporal dimensions of speaking sequences to find objective parameters for the diagnosis of tongue thrust.
SUBJECTS AND METHODS: Thirty-one subjects, aged 14.3 to 37.3 years, with and without tongue thrust were monitored during five repetitions of vowel–consonant –vowel utterances 'asa, ascha, ata, ala, ana, and aka'. Registration of the tongue movement was carried out with an 'Articulograph AG 100®' (Carstens Medizinelektronik Co.). The investigated area was the tip of tongue and 1 and 2 cm further dorsal. The dimensions of geometric (distances, angles) and time variables of tongue movement were analysed in subjects with and without tongue thrust.
RESULTS: Statistical analysis of the speaking sequences showed significant differences between both groups of subjects concerning time variables in comparison with geometric variables. The movement between the first vowel and the palate contact and the first and the second vowel showed the highest number of significant differences. Concerning the region, most differences could be found at the tip of the tongue. For each area of the tongue specific utterances could be found, which showed a maximal number of significant differences between both groups.

CONCLUSION: Analysis of spatial and time intervals of articulatory movements using electromagnetic articulography offers the chance for an objective diagnosis of tongue thrust. Depending on the area of the tongue, suitable specific utterances could be found.

65 TENSILE STRENGTH OF REINFORCED LASER WELDED JUNCTIONS OF ORTHODONTIC WIRES

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AIM: Laser welding of orthodontic wires offers the possibility to connect stainless-steel alloys without using foreign materials. Former studies have shown a decrease of tensile strength due to laser welding. A new type of reinforced connection was investigated concerning the ideal combination of the laser parameters to achieve maximal tensile strength.
MATERIAL AND METHODS: The material used was cold-hammered wire (Remanium®, Dentaurum) with a strength of 0.8 mm. Two pieces of wire were connected end to end. To reinforce the connection, a piece of wire either 4 or 8 mm was welded parallel to the end-to-end connection. The laser welding was carried out using a Heraeus Haas Laser 44 P (Nd:YAG). Applying 1.0 mm as the constant focus size, seven combinations of reinforcing length and pulse duration were tested with a 10-step modification of the pulse power from 0.5 to 1.4 kW in each group. Each connection was tensile tested.
RESULTS: For each combination of reinforcing length and pulse duration, an optimal pulse power exists with regard to maximal tensile strength. An increased divergence of the pulse power from this optimum always leads to an increased reduction of the maximal tensile strength. Compared with a reinforcing length of 4 mm, connections with 8 mm showed an increase in maximal tensile strength and less variation of the measured values. By reinforcing the end-to-end connection, the maximal tensile strength could be improved 57–77 per cent.
CONCLUSION: It was established that for achieving an optimal laser welding seam in wires, a suitable combination of the parameters focus size, pulse duration, and pulse intensity is necessary. The maximal tensile strength can be increased by reinforcing the end-to-end connection with a piece of wire welded parallel to this connection.

66 CLINICAL COMPARISON OF CANINE RETRACTION WITH SLIDING MECHANICS AND THE SLIDING HOOK METHOD

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AIM: To clinically compare canine movement using sliding mechanics (SM) and the sliding hook (SH) method, and to determine the amount of movement, tipping, and rotation of the canines as well as molar anchorage loss.
SUBJECTS AND METHODS: Nineteen patients (2 boys, 17 girls) with an average age of 14 years 8 months who required orthodontic treatment, including upper premolar extractions. Retraction of the maxillary canines was undertaken with either SM or SH in the left and right quadrants. With SM a 0.016-inch diameter archwire and elastomeric chain was used in one quadrant and in the other a SH and chain. The preliminary force used for each part was 350 grams and the movement of canines as well as their rotation and tipping was measured through clinical procedures and compared. Molar anchorage loss in each section was also measured.
RESULTS: The amount of movement of the canine crowns with SH was 1.86 mm in a month and 1.96 mm for SM. The amount of movement with either method was not significantly different. Tipping of the canines for each millimetre of movement was 1.23 degrees with SH and 1.69 degrees for SM, which was significantly different ($0.001 < P < 0.05$). Rotation of the canines for each 1 mm of movement with SH was 4.4 degrees and for SM 2.58 degrees ($0.01 < P < 0.05$). The average movement of the molars was one-seventh that of the canines.
CONCLUSION: Regarding lower canine tipping, the SH method would appear to be more suitable for canine movement.

67 BIOMECHANICS IN LINGUAL ORTHODONTICS

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AIM: To investigate the reason for the ‘bowing effect’ and develop a method of prevention.
MATERIAL AND METHODS: In wax typodonts ($n = 6$) different kinds of anchorage control (group A, B, C) were simulated to investigate the so-called ‘bowing effect’ and compared with the labial technique ($n = 3$). The principles developed for the segmented arch technique (centre of resistance, moment, moment to force ratio, etc.) were used to describe the force and moment systems acting in group A, B, and C anchorage lingual cases.
RESULTS: In all anchorage groups the same force- and moment-systems were found as with labial bonded cases ($P < 0.02$). The origin of all differences was produced because the retractive or protrusive force was acting lingual from the centre of resistance ($P = 0.01$). The side-effects were similar to the undesired side-effects in labial bonded cases ($P = 0.001$).
CONCLUSION: A theoretical approach is described and proved in typodont cases to manage the acting force and moment systems in lingual extraction cases. The use of transpalatal and lingual arches is also necessary in lingually treated cases to prevent undesired root movements in the buccal segments.

68 CHANGES IN CENTRIC RELATION IN CLASS II DIVISION 1 PATIENTS AFTER MANUAL-THERAPEUTIC TREATMENT

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AIM: To demonstrate the changes in centric relation (CR) in Class II division 1 patients after manual therapy and/or osteopathy.
SUBJECTS: Nineteen patients with Class II division 1 malocclusions.
METHODS: Prior to the start of orthodontic treatment all patients with symptoms of craniomandibular or cranio-cervical disorders underwent manual-therapeutic and osteopathic treatment. CR was recorded before and after this procedure. Dental casts of all patients were mounted in individual programmable articulators. The changes in CR were registered in the sagittal and transverse dimensions.
RESULTS: After physiotherapy in all patients, the transversal midline deviations disappeared in CR ($P = 0.002$). In 17 patients the CR was more anterior then before ($P = 0.001$). Only two patients showed a more posterior position or no change in sagittal relationship.
CONCLUSION: Changes in CR after manual therapy or osteopathy may be the reason for different reactions during functional treatment of Class II malocclusions. In patients with a more anterior CR the adaptation process of the orofacial neuromuscular system will be faster.

69 COMPARISON OF THE EFFECTS OF DIFFERENT FORCE VECTORS ON CRANIOFACIAL MORPHOLOGY

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AIM: To compare the effects of four different extra-oral appliances (with different force vectors) on maxillary and mandibular rotations.
MATERIALS AND METHOD: The data were obtained by retrospective analysis of lateral cephalograms from subjects treated using four different extra-oral appliances. (1) Vertical chin-cap group (VCC), 15 patients, 9 girls, 6 boys, with a mean age of 9 years 6 months. (2) Vertical chin-cap + posterior bite block group (VCC+PBB), 13 patients, 9 girls, 4 boys, with a mean age of 9 years 11 months. (3) Cervical headgear group (CervHG), 15 patients, 9 girls, 6 boys, with a mean age of 10 years 3 months. (4) Combined headgear (ComHG) 15 patients, 14 girls, 1 boy, with a mean age of 10 years 2 months. Pre- and post-treatment radiographs were traced and 17 routine measurements were made to define the skeletal and dental characteristics of the groups. Maxillary and mandibular rotations and sagittal and vertical changes of five landmarks were evaluated using Björk's total, maxillary and mandibular local superimpositions on pre- and post-treatment radiographs.
RESULTS: The anterior rotation of the maxilla by vertically directed forces (VCC) showed a significant difference compared with the posterior rotation of the maxilla by distally directed forces (CervHG group). Forward displacement of ANS was greatest by the most vertically directed forces (VCC). As the force vectors of the appliances moved to a more vertical direction (from VCC+PBB to VCC) the backward translocation of the condyle increased. Anterior rotation of the mandible by vertically directed forces (VCC, VCC+PBB) was greater than by distally directed forces (CervHG, ComHG). The gonial angle decreased only with the most vertically directed force (VCC). Change of the force vector from a vertical to a distal direction by the appliances resulted in a downward displacement of pogonion.
CONCLUSION: As the resultant force vectors are directed vertically, forward displacement of the maxilla is not restricted and permits anterior rotation of the mandible.

70 A LONG-TERM STUDY ON THE EFFECTS OF ORTHODONTIC TREATMENT—PART 1: MAXILLARY PROTRUSION CASES

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AIM: To investigate the relapse in overjet after orthodontic treatment.
MATERIAL AND METHOD: Lateral cephalograms of 44 Japanese (10 males, 34 females, with an average age at the initial visit of 15.9 years) who met the following conditions: (1) overjet <6 mm; (2) treated with multi-bracket system; (3) post-active treatment after at least three years; (4) no history of cleft lip and plate; (5) not treated by orthognathic surgery. The cephalograms were measured using Steiner and Ricketts' analyses at the initial visit (A), the end of active treatment (B), and the end of retention (C), and the amount of change from A to B and from B to C was calculated. The correlation coefficient was calculated between the amount of overjet change from B to C and other data at A and B.
RESULT: There was a correlation between the amount of overjet change from B to C and (1) the axis of the anterior upper tooth and occlusal plane angle at A; (2) the axis of the anterior lower tooth at B; and (3) the amount of change for ANB angle and the axis of the anterior upper and lower tooth during active treatment (from B to C).
CONCLUSION: Relapse post-treatment was related to the amount of change of ANB angle and the axis of anterior upper and lower teeth during active treatment.

71 ORTHODONTIC TREATMENT NEED AMONG CHILDREN UNDERGOING ADENOIDECTOMY

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AIM: To investigate the severity of malocclusion and orthodontic treatment need in children undergoing adenoidectomy by means of the Index of Orthodontic Treatment Need (IOTN).

SUBJECTS: Forty-four consecutive children (mean age 11.6 years) refereed to the State Children's Hospital for adenoidectomy. Forty-four randomly selected children (mean age 12.2 years) served as controls.
METHODS: The same investigator, calibrated in the use of the IOTN, assessed all study models. Posterior rhinomanometry was used for conformation of the clinical findings of nasal obstruction. Intra-examiner reliability was calculated by means of weighted kappa analyses. Statistical analysis (descriptive statistics, Mann–Whitney test) was performed.
RESULTS: Examiner calibration was 0.95 for the Dental Health Component (DC) of the IOTN and 0.86 for the Aesthetic Component (AC). Orthodontic treatment was needed in 49.5 per cent of subjects (grades 4 and 5 DHC) and was desirable (grade 3) in 29.5 per cent of cases. AC score was: grade 1–4, 68 per cent; 5–7, 22.7 per cent; 8–10, 9.1 per cent. In the control group treatment was required by only 13.6 per cent (grade 4 DHC) and desirable in 13.6 per cent (grade 3 DHC). There was a statistically significant difference between the study and control groups in IOTN score ($P < 0.001$). Significant differences were found for posterior crossbite ($P < 0.001$) and the contact point displacement ($P = 0.001$) categories of the DHC. No statistically significant difference was found for other categories in the DHC or AC.
CONCLUSIONS: Children with enlarged adenoids referred for adenoidectomy have a high orthodontic treatment need. Enlarged adenoids are involved in the development of occlusal traits such as posterior crossbite and contact point displacement.

72 PHOTOELASTIC EVALUATION OF A MAXILLARY POSTERIOR CROSSBITE APPLIANCE

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AIM: To demonstrate forces in maxillary alveolar bone generated by activation of a maxillary posterior crossbite appliance in the treatment of posterior buccal crossbite.
MATERIAL: A two-dimensional photoelastic model, ivory-coloured resin teeth, and maxillary posterior crossbite appliance were used.
METHODS: A photoelastic model (PL-3) of the upper arch was constructed to simulate a malocclusion. A transpalatal bar and maxillary anchorage unit were used. The transpalatal archwire was made of 0.036-inch stainless steel. A lingual button was bonded to the buccal and palatal surface of the second molar on each side and two hooks made from 0.032-inch stainless steel were soldered to the transpalatal bar. An elastomeric chain was attached to the hook from a button bonded to the buccal or palatal surface of the maxillary second molars. The model was observed from an anterior and posterior view in a circular polariscope and photographically recorded before and after activation.
RESULTS: Force application on the buccal surface of the second molar created an intrusive and controlled tipping force, while force application on the palatal surface produced palatal tipping and a rotational force.
CONCLUSION: Buccal rather than palatal traction force should be used on a second molar to avoid extrusion and uncontrolled tipping creating occlusal interference.

73 ANALYSIS OF FACTORS AFFECTING THE DURATION OF ORTHODONTIC TREATMENT

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AIM: To evaluate factors affecting the duration of orthodontic treatment with special reference to the timing of treatment.
MATERIAL: Clinical records, dental and cephalic radiographs, and pre-and post-treatment dental plaster casts of 218 successfully treated orthodontic patients aged 6–14 years at the start of the treatment.
METHODS: The patients were classified into four categories according to dental development and the number of treatment stages: one-stage treatment started in the early mixed dentition (l-stgEMD), those started in the late mixed dentition (1-stgLMD), and those started in the permanent dentition (l-stgPD), and two-stage treatment started in the mixed dentition (2-stgMD). Angle malocclusion Classes were recorded. Furthermore, three categories were arranged according to the appliances used during the treatment (fixed, removable, and combinations of fixed and removable). Statistical analysis (two-tailed and Chi-square tests, and advanced regression analysis) was performed.
RESULTS: The patient's age at the start of the treatment, the number of appliances used, the treatment change in PAR score, the number of missed appointments, and the number of extracted teeth accounted for nearly 54 per cent of the variation in duration of the active treatment period. The duration of treatment was shortest in the 1-stgPD treatments and longest in the 2-stgMD treatments. The treatment of Class II patients took more time than that of Class I patients. Treatment with combinations of fixed and removable appliances were of a longer duration than those with solely fixed or removable appliances but most of them were 2-stgMD or 1-stgLMD treatments.
CONCLUSIONS: Starting early prolongs the duration of the active phase of orthodontic therapy. Treatment of Class II division 1 and division 2 malocclusions requires more time than treatment of Class I malocclusions.

74 THE WEIGHT OF CALCIFIED DEPOSITS IN THE PROCESS OF AGEING OF THE PERIODONTAL SPACE

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AIM: The modification of the plasticity of the periodontal tissue has direct consequences on the outcome of orthodontic treatment. The aims of this study were, therefore, to study its microscopic components and, in particular, calcified weight.

MATERIAL: Fifty-one premolars extracted therapeutically or traumatically from 42 subjects aged 16 to 57 years. The premolars came following trauma (32), extractions for orthodontic purpose (12), and car accidents (7).
METHOD: All specimens were decalcified with EDTA and tricolour acetic acid and stained with haematoxylin and eosin. The specimens were grouped according to age. The findings concerning the calcified clusters were classified according to location, shape, size, and relationship with the cementum, dentine, and other components of the periodontal tissue.
RESULTS: In subjects aged 16–30 years no calcified clusters were found in the serial sections. In the 30–40-year-old group calcified clusters appeared as small round conglomerates in the fibrilar cementum area. In seven specimens in this group no calcic clusters were present. In the next age group all specimens had calcified deposits in the periodontal space, of different sizes, either round or having a spread.
CONCLUSION: Calcified clusters in the periodontal space seem to be directly related to age through size and shape. It is believed that an excess of calcified clusters can explain failure in orthodontic treatment.

75 *IN VITRO* EXPERIMENTAL AND NUMERICAL DETERMINATION OF INITIAL TOOTH MOBILITY IN RAT MOLARS

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AIM: To investigate whether experimental and numerical methods developed to study human or pig specimens are suitable for rat molar experimentation and to provide information on the reliability of the calculated strain distributions.
MATERIAL: Segments from the mandibles of Wistar rats aged 8–12 weeks.
METHODS: The specimens were prepared into left and right mandibular sections. One half was investigated in a fresh state, the other was frozen for a period of up to three days. The specimens were analysed using the Mobility Measurement System, a laser-optical set-up developed to measure force/deflection characteristics in three-dimensions under orthodontic loading. Subsequently, the specimens were cut into sections, microphotographs were taken and three-dimensional finite element (FE) models were generated semi-automatically with specialized software. Calculations were performed with the FE package COSMOS/M 2.5 using its 3D solid element and by loading the tooth's crown with force levels from 0.02–0.25 N.
RESULTS AND DISCUSSION: Measured initial tooth displacements at the crown ranged from 0.05 to 0.20 mm with rotations of approximately 2 degrees. The displacements measured for fresh specimens could be reproduced numerically with a set of material parameters, assuming a bilinear behaviour of the ligament with maximum deviations of approximately 20–30 per cent. Frozen specimens showed significantly larger deviations. Strains were highest in the periodontal ligament, with peaks at the alveolar crest and furcation up to 0.3 at a force level of 0.05 N. Strains in the bone were as low as 10^{-5}. These results indicate that numerical as well as experimental methods are suitable for determination of tooth displacements in a rat model. Further refinement of the material parameters using a larger number of specimens is desirable to improve the accuracy of the numerical results.

76 CRANIOFACIAL MORPHOLOGY OF PRESCHOOL BOYS WITH SLEEP-RELATED BREATHING DISORDER

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AIM: To examine craniofacial morphology in preschool boys with and without mild or severe sleep-related breathing disorders.
SUBJECTS AND METHODS: Forty-five preschool boys (age range 3–6 years) selected from the files of the Department of Otorinolaryngology, Saitama Children's Medical Center, Japan, who had no craniofacial abnormalities or neurological disease. Based on a polysomnographic examination, the subjects were divided into three groups: (1) severe sleep-related breathing disorder [$n = 10$, Apnoea index (AI) ≥ 5]; (2) mild sleep-related breathing disorder ($n = 20$, $0 < AI < 5$); (3) no sleep-related breathing disorder ($n = 15$, $AI = 0$). AI was calculated as the mean of apnoeic episodes per hour during sleep, where the apnoeic episode was defined as a cessation of airflow through the nose and mouth for more than 10 seconds. A lateral radiograph was obtained of each subject. Conventional cephalometric measurements were used to assess craniofacial morphology and pharyngeal airway space. Statistical analysis included Kruskal–Wallis and Mann–Whitney–*U* tests.
RESULTS: The examination revealed a characteristic craniofacial morphology for preschool boys with sleep-related breathing disorders. This included a retrognathic mandible, large anterior lower face height, reduced nasal floor length, a large interincisal angle with retroclined lower incisors, a narrow pharyngeal airway space, an anterior tongue base position, and a long soft palate. However, no statistically significant differences were found between mild and severe sleep-related breathing disorder subjects.
CONCLUSION: Children with sleep-related breathing disorders develop a characteristic craniofacial morphology at an early age. An effort to interrupt this adverse craniofacial growth and early adaptation during the growth period would be beneficial.

77 EFFECTS OF THE PENDULUM APPLIANCE IN MOLAR DISTALIZATION

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AIM: To determine the dental and skeletal effects of a non-compliance Pendulum appliance (PA) in upper molar distalization.

SUBJECTS: Eleven Class II patients (6 girls, 5 boys), mean age 14.8 ± 1.8 years, with moderate space deficiency in the upper arch treated with the PA for bilateral distalization of the upper first molars. The PA was worn until a super Class I relationship was obtained. The mean treatment duration was 0.49 ± 0.16 years.
METHODS: Lateral cephalometric headfilms were taken before and at the end of molar distalization and 22 linear and angular measurements analysed to determine skeletal and dental changes. The amount of horizontal movement of the molar and incisor teeth was determined from superimposition of tracings on the PTV plane, and vertical movement from superimposition on the palatal plane. Angular changes were analysed in relation to the SN plane. A non-parametric Wilcoxon test was used to assess significant changes.
RESULTS: Significant changes were as follows: upper first and second molars were moved distally [mean= 2.77 ($P < 0.01$) and 2.10 ($P < 0.01$) mm, respectively] with a mean distal tipping of 5.77 ($P < 0.05$) and 7.50 degrees ($P < 0.051$). The mean anterior movement of the upper incisor was 1.91 mm ($P < 0.01$) without tipping. As nearly the same amount of anterior movement was seen at the lower molar (2.00 mm; $P < 0.01$) and incisor (1.17 mm; $P < 0.05$), no significant change was observed in overjet. Significant skeletal change was observed only in lower anterior face height with an increase of 0.81 mm ($P < 0.05$).
CONCLUSION: The PA is an effective appliance for molar distalization with the advantage of being independent of patient compliance. Side-effects, such as significant distal tipping of the molars, need to be taken into consideration in treatment planning.

78 GINGIVAL RECESSION OF LOWER INCISORS AFTER SURGICAL CORRECTION IN CLASS III PATIENTS

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AIM: To determine the factors that can cause gingival recession after orthognathic surgery.
SUBJECTS: Thirty-one male and 39 female adult skeletal Class III patients (mean age 21.11, 20.9 years) who underwent single or bimaxillary surgery with or without genioplasty.
METHODS: Lateral cephalometric radiographs and dental casts were obtained before and after treatment. Several cephalometric and cast measurements were carried out. The amount of gingival recession was measured from the deepest point of the gingival marginal to the incisal edge on the dental cast using a digital calliper. The average of the four incisor recession measurements was calculated. Independent sample *t*-tests were performed to evaluate whether recession was significantly different according to sex, jaw surgery type, and genioplasty. All cephalometric and cast measurements were analysed by Spearman's correlation analysis.
RESULTS: (1) Gingival recession was not significantly different according to sex, type of surgery, or genioplasty. (2) The mean amount of gingival recession was 0.51 ± 0.38 mm. (3) Upper and lower symphysial width showed negative correlation with gingival recession. (4) The length of treatment, set back, incisor decompensation, and the distance between root apex and labial cortical plate did not show any correlation with gingival recession.
CONCLUSION: Initial upper and lower symphysial width may be a possible indication of gingival recession after orthognathic surgery.

79 CHANGES IN NOSE MORPHOLOGY OF CLASS III PATIENTS FOLLOWING ORTHOGNATHIC SURGERY

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AIM: To assess changes in nose morphology after orthognathic surgery in skeletal Class III patients.
SUBJECTS: Fourteen male and 36 female adult skeletal Class III patients (mean age 21.4, 21.9 years) who underwent orthognathic surgery with or without genioplasty.
METHODS: Lateral cephalometric radiographs were taken on three occasions: the day before surgery (T1), one month after surgery (T2), and 6–12 months after surgery (T3). During clinical examination, the following were measured using a Vernier calliper: greatest alar width, alar base width, minimum nares width, maximum nares width, columellar length, nasal length, nasal base width, and interchellion width. A Kruskal–Wallis test was used to test for significance among the three stages, and the multiple regression method was used to determine the influence of the surgical procedure (maxillary advancement, maxillary impaction, mandibular setback) on nose morphology.
RESULTS: (1) Measurements showing significant differences between T1 and T2 were: greatest alar width, alar base width, minimum nares width, columellar length, and nasal base width. Maximum nares width, nasal length, and interchellion width showed no significant difference ($P < 0.05$). (2) No significant difference was found between T2 and T3. The measurements showing significant differences between T1 and T3 were nasal base width and columellar length ($P < 0.05$). (3) Maxillary advancement had a significant influence on greatest alar width and alar base width, whereas maxillary impaction had a significant influence on minimum nares width and interchellion width ($P < 0.001$).
CONCLUSION: An increase in nasal base width and decrease in columellar length was observed 6–12 months after orthognathic surgery in skeletal Class III patients.

80 SIGNIFICANCE OF THE INDICATOR LINE FOR CLASS III TREATMENT

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AIM: To investigate changes in the length of the Indicator Line (IL; distance from the lowest point on either upper

central incisor to the tip of the nose) achieved by different methods of treatment of Class III malocclusions, retruded maxilla type. This study also aimed to examine the significance of the IL.
SUBJECTS AND METHODS: One hundred and ten Japanese patients treated conventionally and 52 with a Biobloc. Conventional treatment was undertaken without the Biobloc appliance. The IL was measured on the subject's face and utilized a lateral cephalogram. Facial patterns of the patients were classified into seven categories from Ricketts' analysis data. The IL and facial pattern were used to compare treatment of Class III malocclusions with conventional methods and use of Biobloc appliances.
RESULTS: The Biobloc appliance was used in subjects with the greatest degree of malocclusion. The average difference from the ideal IL at the start of treatment was +5.88 mm, compared with +4.87 mm in patients undergoing conventional treatment. For all facial types, subjects treated with the Biobloc appliances were more severe at the outset. For all facial types, the Biobloc appliance was faster and more effective. An average change in the IL of –3.54 mm was achieved in an average of 1.24 years. With conventional methods, an average change of –3.04 mm took, on average, 2.09 years.
CONCLUSIONS: The Biobloc appliance is highly effective in the treatment of Class III malocclusions. If used properly from an early age, extraction and surgical treatment can, in most cases, be avoided. These results confirm the viability of the IL in diagnosing malocclusion.

81 COMPUTER-AIDED POSITIONING OF CONDYLES IN FUNCTIONAL ORIENTATED ORTHOPAEDICS

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AIM: To show the clinical relevance of the construction of splints and functional appliances (FA) in an articulator, based on individual registration of the functional status of the craniomandibular system (CMS).
SUBJECTS: Six patients with functional appliances and six with mandibular splint therapy.
METHODS: All patients were registered with CADIAX-system. Casts of both arches were mounted individually in the Reference-I-articulator. After transferring the mounted casts in the Condyle-Position-Variator (Kopp and Burckhardt, 1999) both FA and splints were produced based on the individual three-dimensional position of the mandible. The differences in condylar position were recorded and compared with those taken by wax-bite using the Condylar Position Analyser. All data were stored and calculated statistically by SPSS 10.0.5 (SPSS Inc., USA).
RESULTS: FA and splints were produced in different condylar positions when using the methods described ($P = 0.001$). Most FA produced, based on wax registrations, showed condylar compression ($P = 0.031$). There were no statistically relevant changes in the antero-posterior direction.
CONCLUSION: Using articulator mounted casts and individually recorded determinants of the CMS seem to be a factor in optimizing therapy.

82 THREE-DIMENSIONAL CHANGES IN CONDYLAR POSITION DURING PRE-ORTHODONTIC MANAGEMENT

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AIM: To answer the question as to whether there are statistically relevant changes in condylar position in orthodontic patients with and without craniomandibular disorders during the pre-orthodontic management phase.
SUBJECTS: Twenty-four patients with and 24 without craniomandibular dysfunction (CMD) who were selected for orthodontic treatment.
METHODS: Manual and instrumental diagnostics including 'Manual Screening' (Kopp, 2000) and 'Occlusal and condylar diagnostics' (Kopp, 2000). With the Condylar Position Analyser (Kopp and Burckhardt, 1999), condylar positions of all patients in both groups were recorded a minimum of five times in the CMD-group (each time after physiotherapy) and four times in the non-CMD-group (once per week). All data were stored and calculated statistically by SPSS 10.0.5 (SPSS Inc., USA).
RESULTS: Patients with CMD showed more condylar displacement during pre-orthodontic management ($P = 0.024$) compared with the non-CMD-group. Most displacements were in an anterior ($P = 0.001$) and caudal ($P < 0.02$) direction. The total amount of three-dimensional change was greater in the CMD-group ($P < 0.05$).
CONCLUSION: Interdisciplinary treatment of CMD patients during pre-orthodontics provides a totally different condylar and mandibular position compared with the beginning of treatment. Therefore screening techniques to detect CMD problems must be used in every patient. Based on this mostly manually orientated data, an interdisciplinary treatment approach should be used before planning and performing orthodontic treatment.

83 SHAPE CHANGES IN THE LOWER DENTAL ARCH AFTER TREATMENT WITH FIXED APPLIANCES

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AIM: To describe shape changes in the lower dental arch after extraction and non-extraction treatment with fixed appliances.

SUBJECTS: Models of the lower dental arch of 122 patients, treated with straightwire appliances, divided in three groups: (1) non-extraction therapy of lower dental arch with possible stripping (n = 51); (2) non-extraction therapy with planned modification of the arch shape, namely Angle Class II division 2 (n = 21); (3) extraction of two lower premolars (n = 50).
METHODS: Occlusograms of the lower dental arch before and after treatment. Clearly identifiable anatomical points were digitized on the outer curve of the perimeter. Euclidean Distance Matrix Analysis (EDMA) was used for the statistics of shape changes (Form Difference Matrix). The basic linear parameters were added (6–6, 3–3, arch length; statistics by paired t-test) and visualization of the shape by curve fitting (spline).
RESULTS: All groups exhibited a statistically significant ($P < 0.05$) change in the shape-relative tapering of the perimeter curve. EDMA statistics $T_{max/min}$ non-extraction 1.084 total and 1.086 anterior, expansion 1.163 and 1.149, extraction 2.225 and 1.140.
CONCLUSIONS: (1) The change in the shape of the lower dental arch by a narrowing of the curve was a common effect of treatment with the straightwire appliances. (2) The change in shape occurred mainly in the relationship of the incisors to the other teeth. (3) In non-extraction treatment, the relative narrowing of the curve occurred mainly as a consequence of sagittal elongation. (4) In extraction treatment, the curve was narrowed mainly due to anterior deepening, whilst the distance 3–3 was not significantly changed.

84 VERTICAL CHANGES OF THE CLEFT-SEGMENTS IN PATIENTS WITH UNILATERAL CLEFT LIP AND PALATE

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AIM: To examine vertical changes of the incisal point and the anterior cleft margins of both segments from birth to 7 years of age.
MATERIAL AND METHODS: A three-dimensional examination was carried out on maxillary plaster models of 44 patients with unilateral cleft lip alveolus and palate (UCLP). A reference plane was calculated between the intertuberosity distance and the canine point on the non-cleft side. Distances from incisal point and from the anterior cleft margins were measured to this references plane at six time points from birth to 7 years of age.
RESULTS: A significant reduction of the vertical distance between incisal point and cleft margin was measured after pre-surgical orthopaedics before lip closure. Prior to palatal closure there was an increase of the distance. After palatal closure, a stabilization of the vertical dimension was found.
CONCLUSION: Pre-surgical orthopaedic therapy can significantly reduce the vertical anterior relationship in patients with UCLP.

85 ORTHOGNATHIC SURGERY IN THE TREATMENT OF MANDIBULAR PROGNATHISM AND OPEN BITE

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AIM: To evaluate the changes in patients with skeletal Class III malocclusions and open bite after mandibular osteotomy.
SUBJECTS: Twenty-eight patients with skeletal Class III malocclusions and an open bite who underwent a mandibular osteotomy between 1980 and 2000.
METHOD: Cephalometric headfilms were measured following orthodontic treatment and surgery. Overjet, overbite, basic cephalometric measurements and anterior facial height (N–Me) divided into middle (N–Sp′), and lower third (Sp′–Me) and posterior facial height (S–Go) were registered.
RESULTS: The mean change in overjet was 5.91 mm and in overbite 4.73 mm. The mean shortening of N–Me was 3.5 mm (maximum: 15 mm) and for Sp′–Me 3.8 mm (maximum: 15 mm). Significant changes also occurred in the values of the inter-incisal angle, mean change 7.35 degrees (maximum increase 22 degrees, maximum decrease 27 degrees) and in Wits parameter (mean decrease 6.67 mm, maximum decrease 15.5 mm, minimum change 1 mm). S–Go showed a mean change of 0.1 mm. The change of point Go was more geometric because of the change in the mandibular line.
CONCLUSION: Marked changes in dental parameters as well as considerable skeletal changes in anterior facial height were found. Unchanged posterior facial height could be an important factor in post-surgical stability of overbite.

86 BONE DENSITY AROUND MAXILLARY CANINES DURING AND AFTER ORTHODONTIC RETRACTION

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AIM: To evaluate bone density around maxillary canines during and after orthodontic retraction using power chain elastics.
SUBJECTS: Thirteen girls between 14 and 16 years of age. Their orthodontic treatment plan required extraction of the maxillary first premolars, then full canine retraction.
METHODS: In all subjects a transpalatal arch was fitted and Roth prescription brackets (0.018-inch) were bonded to the labial and buccal surfaces. Arch levelling and alignment were carried out using 0.014 and 0.016-inch nitinol wires, and then 0.018-inch stainless steel wires were placed to start canine retraction. Retraction was undertaken for both sides using an elastic power chain with a light force level (150–200 g) confirmed by a Correx gauge until contact was established between the maxillary canines and second premolars. Digital radiographs were obtained using a direct digital radiographic imaging system (Digora unit) at three time intervals: T_0 just before canine retraction, T_1 after

6 weeks, and T_2 three weeks following canine retraction. The projection of the canine area was standardized at a fixed target-film density and fixed exposure time (0.02 seconds). The dental image on the computer monitor consisted of points or pixels each having a certain density value (0–255 pixels). The Digora unit measured the density value (pixels) within the marked area parallel to the lamina dura on the pressure and tension sides. Three readings for each area measurement were recorded and the mean grey level for each side was calculated to ensure accuracy. Mean density values were determined. The calculated data were statistically analysed.
RESULTS: The pressure sides showed a significant decrease in bone density $P < 0.01$ at T_1 and T_2. The tension side showed a significant decrease $P < 0.01$ at T_1 then a significant increase $P < 0.01$ at T_2. Significant differences were recorded between left and right sides.
CONCLUSIONS: Canine retraction with a power chain results in a significant decrease in bone density throughout the retraction stage in the pressure area. A significant increase in density was observed on the tension side in the latter stages of canine retraction. Bone density varied between right and left sides.

87 EVALUATION OF TISSUE CHANGES AFTER EARLY THERAPY IN SUBJECTS WITH CLASS III MALOCCLUSIONS

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AIMS: To prospectively and clinically evaluate hard and soft tissue changes after Delaire orthopaedic facemask therapy in children with skeletal Class III malocclusions caused by maxillary retrognathism.
SUBJECTS: Thirteen subjects (7 boys, 6 girls) with a mean age at the beginning of treatment of 6.5 years. None of the subjects had any other craniofacial anomalies and had not undergone prior orthodontic treatment.
METHODS: All patients were treated with an orthopaedic facemask to correct the antero-posterior dimension. Lateral cephalograms were taken before (T0) and after (T1) treatment and a traditional cephalometric analysis was conducted.
RESULTS: (1) The maxilla was displaced anteriorly (SNA +1.96°; Co–A +3.19 mm; SNP–A +2.07 mm; ANB +2.61°; AoBo +2.58 mm). (2) The mandible rotated posteriorly (SNB –1.23°). (3) No statistically significant changes were observed in dental measurements. (4) The Class III concave profile became more balanced. The skeletal profile convexity increased (LELs +1.54 mm; NB^LsPgc +3.73°; NcPtaMe –3.77°; NcPgcHL +3.92°).
CONCLUSION: Facemask therapy improves Class III malocclusions by a combination of skeletal and dental changes. Treatment results in a more convex and harmonious profile.

88 *IN VITRO* EVALUATION OF ELASTOMERIC CHAINS

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AIM: To assess the loss of strength of the same elastic orthodontic chains when subjected to tensile loads for different periods of time in different environmental conditions.
MATERIALS: A total of 690 elastic chains were evaluated. Three different types were studied: extra-narrow, narrow, and wide. Each type of elastic chain was evaluated in two available commercial presentations: transparent and grey.
METHODS: Sixty-nine different groups were formed. Each group contained 10 elastic chains. Six groups served as the controls and the other 63 groups were subjected to tensile loading until the chain's initial length was doubled, during different periods of time (1, 3, 24, 96, 160, 360, and 720 hours). The experiments were performed under different environmental conditions: air, water at 20°C, water at 37°C, and saliva at 37°C. The initial length (L0), temporary deformation (L1), and permanent deformation (L2) were recorded. The tensile strength was measured using an Instron machine.
RESULTS: The main strength loss occurred during the first hour. The initial strength decreased 35 per cent in the air group, 47 per cent in the saliva group, 41 per cent in the water at 20°C group and 48 per cent in the water at 37°C group. Thus, the major decrease was observed in the elastic chains subjected to traction in a salivary environment. When studying the different environments alone, thickness and the distance between the links were the primary factors in the loss of strength.
CONCLUSIONS: The loss of strength depends on time, environmental conditions, thickness of the elastic chains, and distance between the links. These results can offer useful guidelines in clinical treatment.

89 EXPRESSION OF VASCULAR ENDOTHELIAL GROWTH FACTOR IN THE CONDYLE DURING MANDIBULAR FORWARD POSITIONING

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AIM: To identify the temporal expression of vascular endothelial growth factor (VEGF) in the condyle in response to forward mandibular positioning.
MATERIAL AND METHODS: One hundred and fifty female, 35-day-old Sprague–Dawley rats were randomly divided into 10 groups, with 10 rats in each experimental subgroup and five rats in each control subgroup. In the experimental groups, the mandible was kept in a continuous forward position. The rats were sacrificed on days 3, 7, 14, 21, 30, 33, 37, 44, 51, and 60. Sections were cut through the condyle in the sagittal plane and stained with anti-VEGF antibody. Each section was counter-stained with haematoxylin for observation of the cellular response.

RESULTS: In the experimental groups, the expression of VEGF reached its peak on day 21. Expression was concentrated in the fibrous, proliferative and hypertrophic zones of the mandibular condyle. The experimental groups showed a significant increase in the level of VEGF expression when compared with the controls. Both groups showed more VEGF expression in the posterior part of the condyle.
CONCLUSION: Continuous mandibular forward positioning results in an increase in the expression of VEGF in the condyle. This implies that angiogenesis is enhanced in the mandibular condyle during forward mandibular positioning.

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90 BIOSYNTHESIS AND SECRETION OF OSTEOPONTIN IN MG-63 CELLS UNDER MECHANICAL PERTURBATION—A ^{35}INCORPORATION APPROACH

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AIM: To gain insight into the molecular mechanism of the effects of mechanical stimulation on osteogenic cells.
MATERIAL: MG-63 human osteosarcoma cells, assay for determining cellular activity, [^{35}S]methionine, polyclonal antibody LF-123.
METHODS: MG-63 cells were cultured on fibronectin-coated half-ball-shaped silicon rubber membranes that were geared in a cell box connected to a computer-controlled vacuum pressure system. Mechanical strain of 0.5 per cent, 3 cycles/minute (10 minutes on and off) was applied to stretch the cells. At 1, 2, and 4 hours (short-term) as well as 12, 24, and 36 hours (long-term) after the start, the supernatant was taken and the proteins were separated by 10 per cent SDS–PAGE electrophoresis and then exposed to X-ray film.
RESULTS: Using western blotting, osteopontin was confirmed to be a 60–64 kDa protein secreted from MG-63. Without mechanical perturbation, there was a relatively stable level of osteopontin in the supernatant from 12 to 36 hours. With mechanical stretching of 0.5 per cent, 3 cycles/minute (10 minutes on and of), osteopontin was increased nearly three-fold only at the 12th hour indicating an early response to mechanical stretching. By reducing the time of exposure to 4 hours (but not 1 and 2), significant response was observed at the 4th hour in the stretched group. The results of this study indicate that low magnitude and low frequency of mechanical loading could possibly up-regulate the function of osteoblasts in favour of its role in mechanically induced remodelling of bone in orthodontic tooth movement.
CONCLUSION: Osteogenic cells do respond to the mechanical milieu early. Low levels of mechanical strain can favourably increase the biological function of osteogenic cells, which suggests the application of lighter and intermittent forces (eventually temperature-controlled as in the Cu/NiTi) to move teeth in clinical orthodontics.

91 QUANTITATIVE MEASUREMENT OF MYOSIN HEAVY CHAIN mRNA WITH COMPETITIVE PCR IN MASTICATION MUSCLES FOLLOWING MANDIBULAR ADVANCEMENT IN PIGS

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AIM: Functional treatment of Class II malocclusions is connected to adaptation of mastication muscles. The aim of the study was to measure the amount of mRNA for myosin heavy chain (MHC) of fibre types I and II with competitive PCR.
MATERIAL: The experiments were carried out on 10-week-old pigs (six test animals, six controls) over a 28-day period.
METHODS: Six pigs were fitted with acrylic bite blocks for permanent sagittal advancement of the mandible. Tissue was taken from three different regions of the masseter, two regions of the temporalis and from the medial pterygoid and geniohyoid muscles. The 84 samples were used for total isolation of total RNA. For measurement of specific amounts of mRNA of MRC from type I and IIb, the competitive PCR was applied. For quantitative identification of the amount of RNA, a competitor was developed and served as an internal standard.
RESULTS: There was a remarkable difference for MHC mRNA between the individual animals and a shift from type II to type I fibres in the pigs with advancement of the mandible. This increase was emphasized in regions of muscle stretching, for instance, in the anterior part of masseter muscle with a mean value of 403.25 pg MHC I mRNA compared with the posterior part with 132.5 pg MHC I ($P < 0.01$). In control animals there was a low difference between the anterior masseter region with a mean value of 310.0 pg MHC I mRNA and the posterior region with 402.5 pg MHC I mRNA (n.s.).
CONCLUSION: Experimental advancement of the mandible in pigs leads to a shift from type II to type I mRNA for MHC. This increase of type I mRNA is emphasized in regions of marked muscle tension after permanent mandibular advancement. The explanation for this phenomenon is the higher availability of oxygen in type I fibre for improvement of performance in the adaptation process.

92 PLASMA LIGHT VERSUS A HALOGEN CURING UNIT FOR BRACKET BONDING—A COMPARATIVE STUDY

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AIM: To compare, *in vivo*, the bonding time by quadrant and the bracket survival time using a plasma curing light

(Apollo™ 95E) or a conventional halogen curing light (3M™ XL 3000).
MATERIAL: Six hundred and twenty-one brackets bonded to 46 patients.
METHODS: Contralateral quadrants of each patient were bonded with both lights in a random order. The time was measured after teeth cleaning, etching, bonding application, and until end of bracket placement in each quadrant. Three hundred and eleven brackets were bonded with the Apollo™ light and 310 with the 3M™ light. The mean follow-up time of the patients was (±SD) 5.8 ± 2.7 months (from 11 days to 9.7 month).
RESULTS: The bonding time with the Apollo™ curing light was significantly shorter (310.4 ± 93.2 s/quadrant, mean ± SD) than with the 3M™ light (396.3 ± 180.3 s/quadrant, $P < 0.001$). Kaplan–Meyer analysis showed that the mean survival time of the brackets was 217 days. There was no significant difference in the survival time between the two methods. There was no relationship between the treated quadrants, the time needed for bonding or bracket survival time.
CONCLUSION: The Apollo™ curing method reduces bonding time, without affecting the bonding failure rate.

93 APICAL RESORPTION AFTER ORTHODONTIC TREATMENT

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AIM: To determine the extent of resorption in upper incisors in patients treated with fixed appliances to correct their deep bite.
SUBJECTS: The length of the upper and lateral incisors was measured in 70 patients who finished orthodontic treatment with fixed appliances during the period from the 1st July to the 23rd December, 1998.
METHOD: The amount of resorption before and after treatment was measured on panoramic radiographs with Vernier callipers. All incisors were measured in the longitudinal axis of each tooth. The length of the crown and root were measured separately. To correct the influence of projection, the dimensions were calculated.
RESULTS: The average resorption of all four incisors was 1.31 mm, maximum 3.83 mm. The size of resorption linearly correlated with the length of treatment. No correlation was found between the original length of the root and the size of resorption. No influence was found for removable appliances, the use of rectangular archwires or Class II elastics during treatment. Extraction treatment showed significant influence compared with non-extraction. It was also found that Burstone's continuous intrusion arch was a risk factor in resorption.
CONCLUSION: Resorption of the root apex is a common phenomenon during orthodontic treatment with fixed appliances. In this group of 70 treated patients the average resorption was 1.31 mm, which is in agreement with the results from other studies.

94 NEURAL NETWORK BASED IDENTIFICATION OF VERTICAL DIAGNOSIS THROUGH CEPHALOMETRIC TECHNIQUES

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AIM: Application of intelligent computation techniques to obtain the vertical diagnosis of a group of patients.
MATERIALS: Cephalometric evaluation carried out according to the Ricketts' technique, using supervised and unsupervised neural networks (NN) paradigms.
METHOD: Different artificial NN paradigms were employed to provide the vertical diagnosis through both supervised and unsupervised learning. The training set utilized for NN learning was constructed on the basis of data obtained from 210 patients. For each patient, the following features were available: age, facial axis, facial plane, ANS-Xi-Pm, mandibular arch, BANA-FHpl, Go-Gn-FHpl, and a vertical facial evaluation assessed by an expert orthodontist from the above measurements. An eight-component pattern vector then represented each case in the training set. The NN data processing was performed according to two different NN approaches: one supervised learning paradigm based on feed forward back-propagation NNs and one unsupervised learning procedure based on the Kohonen self-organizing map NN.
RESULTS: The performance of the NN based classification systems in providing a correct vertical diagnosis was assessed and the computational speed was evaluated. Depending upon the number of vertical skeletal categories considered, the NN success rate ranged from 50 to 90 per cent.
CONCLUSION: These preliminary findings support the potential use of artificial NN for cephalometric diagnosis both in the clinical and research setting. The success rate of the computational approach to cephalometric vertical diagnosis will certainly increase in the near future with more extensive training of NN and with more sophisticated artificial NN paradigms.

95 PROFILE CHANGES AFTER SURGICAL-ORTHODONTIC TREATMENT OF CLASS III MALOCCLUSIONS

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AIM: To determine the effects on facial profile of bimaxillary surgery and mandibular set-back surgery only.
SUBJECTS AND METHODS: Twenty subjects with Class III malocclusions, divided into two equal groups. Ten had been diagnosed with maxillary retrusion and mandibular prognathism and formed the first group. In this group, surgical treatment consisted of simultaneous Le Fort I osteotomy to advance the maxilla and a bilateral sagittal split osteotomy to set-back the mandible. The second group were diagnosed with mandibular prognathism and surgical

treatment consisted of a bilateral sagittal split osteotomy. For each patient, the pre- and post-operative radiographs (1 year after surgery) were taken either in centric relation or centric occlusion with the lips in repose. Ten skeletal and 19 profile measurements were evaluated. Statistical analysis was performed using SPSS.
RESULTS: In both groups the skeletal and soft tissue facial profiles were straightened, improving the dentofacial aesthetics. LiBPg angle, E-upper lip distance, horizontal lower lip and soft tissue pogonion decreased significantly ($P < 0.05$, $P < 0.01$) and vertical lower lip measurement increased significantly ($P < 0.01$) in both groups. Vertical and horizontal movement of pronasale showed a significant difference ($P < 0.01$) between the groups, while nasal tip elevation and forward movement was seen in the bimaxillary group.
CONCLUSION: The profile changes following bimaxillary jaw surgery were similar to those in the mandibular set-back group, with the exception of the changes seen in nasal tip projection and elevation.

96 TEMPOROMANDIBULAR JOINT GROWTH DIRECTION CHANGES RELATED TO THE MANDIBULAR PLANE ANGLE IN HERBST SUBJECTS

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AIM: To compare the direction of mandibular glenoid fossa displacement and condylar growth as well as 'effective' temporomandibular joint (TMJ) changes in three vertical facial type groups of subjects treated with the Herbst appliance.
SUBJECTS: Thirteen high-angle (ML/NSL ≥ 37°), 17 low-angle (ML/NSL: ≤ 26°) and 38 normal-angle (ML/NSL 26.5–36.5°) subjects were examined. The mean pre-treatment age was 12.4 years.
METHOD: Lateral head films from before (T1), after (T2), and 5 years after (T3) Herbst treatment were analysed. Glenoid fossa displacement and condylar growth were assessed with a modification of the method described by Buschang and Santos-Pinto (1998). Effective TMJ changes (the sum of condylar remodelling, glenoid fossa remodelling, and positional changes of the condyle within the fossa) were assessed with a modification of the method described by Creekmore (1967).
RESULTS: During treatment, glenoid fossa displacement was, in all subject groups, directed anteriorly and inferiorly. No differences were found between the groups. Condylar growth and 'effective' TMJ changes were directed superiorly and posteriorly. Changes in the posterior direction were more apparent in the high-angle group. Post-treatment glenoid fossa displacement was directed posteriorly in all three groups. Condylar growth and 'effective' TMJ changes were directed more vertically in comparison with the treatment changes and especially in low-angle subjects.
CONCLUSION: Independent of the vertical facial type, the direction of glenoid fossa displacement and condylar growth as well as of 'effective' TMJ changes was only temporarily affected by Herbst treatment. In high-angle subjects condylar growth and 'effective' TMJ changes were more apparent in the posterior direction. This was true for both the treatment and post-treatment periods.

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97 NEUROSENSORY ASSESSMENTS IN THE OROFACIAL REGION—VON FREY MONOFILAMENTS VERSUS PRESSURE ALGOMETRY

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AIM: To evaluate topographic differences in superficial and deep somatic sensitivity in the orofacial region, to determine the effects of gender on the neurosensory measurements, and to assess their short- and long-term reliability.
METHODS: Thirty healthy dental students (15 males, 15 females) participated in the study. Cutaneous sensitivity was assessed by means of the von Frey aesthesiometer. Stimulus–response curves (S–R) were determined with a defined set of monofilaments at four different locations in the orofacial area: the emergence of the infra-orbital nerve (Io) and the mental nerves (Me) and the regions of the masseter (Ms), and anterior temporalis. An additional measurement was performed at the tenar eminenence (Te). Pressure pain thresholds (PPT) were assessed by means of a pressure algometer at the masseter and anterior temporalis muscles and tenar eminence. Replicate measurements were obtained during four separate sessions over a one-month period. Data collected were analysed by means of a repeated measurements analysis of variance (ANOVA).
RESULTS: S–R and PPT values showed topographic differences. The cutaneous sensitivity was significantly higher ($P < 0.001$) at sites Io and Me. The PPT were significantly lower at Me ($P < 0.001$). The S–R curves were not significantly different between males and females ($P > 0.05$). On the other hand, PPT were significantly lower in females than in males ($P < 0.001$). The S–R curves (slope and intercept) and the PPT did not change significantly over time ($P > 0.05$) with correlation coefficients ranging from 0.39 to 0.93. The reliability of both neurosensory measurements was generally good but it was better over short (one week) than over long-term periods (one month).
CONCLUSIONS: The von Frey aesthesiometer and the pressure algometer are reliable tools for neurosensory assessments in the orofacial area.

98 DEVELOPMENT OF A TITANIUM MESH SUBPERIOSTEAL IMPLANT FOR ORTHODONTIC ANCHORAGE

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AIM: To develop a subperiosteal pure titanium mesh implant for orthodontic anchorage.
MATERIAL: Thirty-eight femur bones of 20 Japanese white rabbits (2.5–3.0 kg) and two types of titanium mesh subperiosteal implants, 80 and 40 mesh/inch (24 each).
METHODS: Surgical adhesion of the subperiosteal mesh implant was used as the initial anchorage and the specimens were implanted subperiosteally on the femur of the rabbit bone for one week and one and three months. After implantation they were analysed by X-ray diffraction and the bonding strengths of the implants to bone were determined by a pull-off method. In addition, the bone tissue around the specimens at one and three months after implantation was investigated histologically.
RESULTS: The bond strengths of the subperiosteal implants showed no significant differences at one week and one month after implantation, but at three months after implantation the values were significantly higher. X-ray analysis of specimens: in both groups, new bone formation was seen around the implant at one and three months after implantation. In the non-bonded group, the implant specimens were moved and suspended from the femur surface. Histological observation of specimens: new bone formation was observed in both groups one and three months after implantation. In the bond group, surgical adhesion was observed at one month after implantation but was then resorbed and replaced by new bone.
CONCLUSION: Subperiosteal titanium mesh implants have the possibility to be used as orthodontic anchorage.

99 PREMATURE EXTRACTION OF DECIDUOUS CANINES—A CAUSE IN MIDLINE SHIFTS

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AIM: To estimate changes in the position of anterior teeth (midline), due to premature extraction of deciduous canines on one side of the dental arch.
SUBJECTS: Thirty patients (12 females, 18 males), average age 9 years 2 months, who were not undergoing orthodontic treatment. Unilateral extraction of a deciduous canine in the upper or lower arch had previously been carried out in all the children.
METHOD: Analysis of study casts and dental panoramic radiographs. All results were statistically analysed. The average shift for each arch was calculated and the upper and lower arch were compared.
RESULTS: The midline shift in the upper arch was 2.71 ± 0.76 mm, and in the lower 2.29 ± 0.49 mm. *t*-test comparison of midline shifts of the upper to the lower jaw were not statistically significant ($P = 0.23$).
CONCLUSION: Premature unilateral extraction of deciduous canines leads to a midline shift, which will require orthodontic therapy

100 IMPROVEMENT OF A NEW TITANIUM MESH PLATE SUBPERIOSTEAL IMPLANT APPLIED AS ORTHODONTIC ANCHORAGE

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AIM: To improve a titanium mesh subperiosteal plate implant for use as orthodontic anchorage.
MATERIAL: Twenty femur bones of 14 Japanese white rabbits (2.5–3.0 kg). The specimens were two types of mesh subperiosteal implants: the wire mesh type and the mesh plate type (12 each). Both implants were made from pure titanium.
METHODS: The specimens were implanted in the subperiosteal surface of the femur bone for one and three months. After implantation they were analysed by X-ray diffraction and the bonding strength of the implant to bone was determined by a pull-off method. Furthermore, the bone tissue around the specimens at one and three months after implantation was histologically investigated.
RESULTS: X-ray analysis of specimens showed new bone formation on both types of mesh implants one and three months after implantation. Both types of mesh implants showed higher bond strength after three months than after one month of implantation. The bond strength values of mesh plate-type implants were significantly higher than the wire mesh-type implants ($P < 0.01$). Histological observation of the implant specimens showed, for both mesh-type implants, new bone regeneration in the subperiosteum one and three months after implantation.
CONCLUSION: It is suggested that the improved titanium mesh plate subperiosteal implants may be useful for orthodontic anchorage.

101 EFFECTS OF COMBINED USE OF CLASS II ACTIVATOR WITH A VERTICAL CHIN-CAP

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AIM: To compare the effects of the combined use of an activator with a vertical chin-cap with an activator with posterior high-pull headgear in high-angle skeletal and dental Class II cases.
SUBJECTS: Twenty-five individuals with increased vertical face heights and skeletal Class II and dental Class II division 1 malocclusions.
METHODS: Activator and posterior high-pull headgear (A+HHG) was used in 12 patients (6 girls, 6 boys, with a mean age of 12 years 4 months) and a vertical chin-cap (A+VCC) in 13 subjects (8 girls, 5 boys, with a mean age

12 years 2 months). The treatment time for the A+HHG group ranged between 7 and 26 months and for the A+VCC group between 3 and 9 months. Pre- and post-treatment lateral cephalograms and hand-wrist radiographs were evaluated by the superimposition methods of Björk and Helm *et al*. Statistical analysis (paired *t*-test, ANOVA) was performed.
RESULTS: The maxillary rotation in the A+HHG group was found to be posterior whereas there was an anterior rotation tendency in the A+VCC group. The difference between the groups was found to be statistically significant. In the A+VCC group mandibular anterior rotation was found to be significant, but this difference between the groups was not statistically significant. The combined use of an A+VCC was found to be as effective as A+HHG in the correction of sagittal jaw discrepancy and more effective in preventing an increase in anterior face height and downward displacement of the chin. However, it was found to cause more significant protrusion of the mandibular incisors.
CONCLUSION: The combined use of an A+VCC was found to be a suitable treatment approach in high-angle skeletal and dental Class II cases with mandibular retrusion.

102 COMPARISON OF THE EFFECTS OF TWO DIFFERENT ANCHORAGE SYSTEMS

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AIM: To compare the effects of two different mandibular anchorage systems used against a three-dimensional (3D) bimetric maxillary distalizing arch.
SUBJECTS AND METHOD: The Wilson rapid molar distalization appliance for Class II molar correction was used in 20 patients. The open coil springs were activated with bent Omega stops and Class II intermaxillary elastics. Two groups of 10 patients were formed. In the first group (8 girls, 2 boys, with a mean age of 11 years 9 months), the mandibular anchorage was gained by a lip bumper (which was in contact with the labial surface of the lower incisors) with a standard lingual arch made of 0.9 mm stainless steel. The second group (5 girls, 5 boys, with a mean age of 12 years 10 months) had a 0.016 × 0.016-inch utility arch, with a 3D lingual arch for anchorage. Lateral cephalograms taken before and after treatment formed the material for the research. A Wilcoxon test was used to statistically evaluate the treatment effects. Differences between the groups were determined by Mann–Whitney–*U* test.
RESULTS: Extrusion of the mandibular first molar was statistically significant in both groups. The increase in the lower occlusal plane was found to be statistically significant with both anchorage systems. The incisal edge of the mandibular incisor moved forward significantly in both groups; however, the protrusion in the utility group was significantly greater than the protrusion in the lip bumper group. In both groups significant mandibular incisor proclination was observed. Comparison of the two anchorage units showed that there was significantly greater proclination in the utility than in the lip bumper group.
CONCLUSION: Both anchorage units successfully enhance mandibular first molar anchorage. However, especially in the utility group, mandibular incisor anchorage control seems to be inadequate.

103 CONVERSION OF CONVENTIONAL LATERAL CEPHALOMETRY TO NATURAL HEAD POSTURE USING THE CVT/HOR ANGLE

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AIMS: To introduce a method to obtain natural head posture (NHP) on conventional lateral cephalograms by orientating the film according to the CVT/HOR angle (cervical vertebrae tangent to true horizontal line angle).
SUBJECTS: Fifty-nine subjects (27 boys, 32 girls) aged 9–11 years with a Class I occlusion, average profile, symmetrical face, without any vision or hearing problems, who had not undergone orthodontic treatment or orthognathic surgery.
METHOD: NHP lateral cephalograms were obtained for all subjects and two tracings were made. The tracings were then divided into two groups: a control group of 59 tracings including the chain for NHP analysis and an experimental group of 59 tracings with the chain excluded. The mean value of CVT/HOR angle was calculated for the control group. In the experimental group the conventional tracing was orientated to a position such that their CVT/HOR equalled that of the control groups. The CVT is a line connecting two points: the most postero-superior aspect of odontoid process and the most postero-inferior aspect of the third cervical vertebral body. CVT/HOR is the angle between CVT line and an imaginary horizontal line. Imaginary horizontal (IH) is a line drawn horizontally from nasion according to the average CVT/HOR angle in the control group. Imaginary vertical line (IV) was drawn from nasion perpendicular to IH. According to IV,IH for the experimental group, the NHP measurements of the group were calculated. With correction of conventional cephalometry by rotation according to the proper CVT/HOR angle, the values that equal the NHP measurements were determined.
RESULTS: According to the orientation of the CVT/HOR angle, variations of each measurement showed highly positive correlations between the two groups. With an increasing CVT/HOR angle (head extension), all measurements were increased.

104 EVALUATION OF THE EQUILIBRIUM OF THE CRANIOFACIAL COMPLEX COMPONENTS USING LATERAL CEPHALOGRAMS

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AIMS: To determine the interrelationship of some craniofacial complex components and whether this or a relationship equilibrium exists in Class II and III patients.

SUBJECTS: Forty-two patients (24 girls, 18 boys) aged 17–25 years. All were without any problem of jaw fracture, TMJ, cleft lip and palate, and had not undergone orthodontic treatment or orthognathic surgery. They were selected on the basis of simple randomized sampling and divided into two groups (30 Class II and 12 Class III subjects).
METHOD: Pre-treatment lateral cephalograms were obtained. The cephalograms were traced and 15 intracranial landmarks were distinguished according to Jarabak's analysis. Linear measurements: N–Me, SN, SAr, Ar–Go, Go–Me, N–Go, S–Gn, S–Go. Angular measurements: N–S–Ar, S–Ar–Go, Ar–Go–Me, Ar–Go–Y, N–Go–Me. The percentage of PFH/AFH was also calculated. Mean and standard deviations were calculated using the Excel 97 software program. The relationship between linear and angular measurements in the two groups was separately investigated using the linear regression method. Finally *t*- and Fisher's tests were preformed on both groups of measurements.
RESULTS AND CONCLUSION: Linear regression analysis showed significant correlation in the Class II group, which was higher than in the Class III group. In the Class II group a significant correlation was found between FHR with upper gonial angle, gonial angle, SN.Go.Gn angle, Sn.Mp angle and the sum of the posterior angle. In the Class III group a significant correlation was found for SNA with SNB, facial angle with *y*-axis angle, Ar–Gn, Go–Gn, and facial length with Ar–Gn.

105 GEOMETRIC EVALUATION OF MANDIBULAR MIDLINE DISTRACTION

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AIM: To evaluate the effects of midline distraction on the position and rotation of the mandibular base and condyle, and to compare these findings with those of a distraction patient.
MATERIALS AND METHODS: A geometric model was constructed using the intercondylar and condyle-to-distraction site dimensions of a symphysial distraction patient to simulate and forecast the positional changes of the mandibular condyle during midline distraction. Simulation of 6 mm distraction with a specially designed rigid distraction device revealed that distraction would cause 3 mm expansion of the condylar heads laterally out of the condylar fossa on both sides. Simulative segmentation of the posterior rigid arms of the device allowing rotation around mandibular first premolars resulted in relapse of the condyles to their original position. Each condyle underwent 3 degrees of postero-lateral rotation as a result of distraction. This rotational movement was preferable to movement of the condyles out of the fossa laterally. The results achieved with the geometric model were confirmed with the cast measurements of the individual patient.
CONCLUSION: The relapse of the condylar heads from the expanded position following segmentation with the rigid mandibular midline distraction appliance shows that this movement forces the condyles into an unstable musculoskeletal position. Care should be taken to overcome this undesirable effect. This should be possible by segmentation of the devices in order to convert lateral movement into rotational movement, which is more acceptable.

106 POSSIBLE ASSOCIATION OF TEMPOROMANDIBULAR JOINT PAIN AND DYSFUNCTION WITH A POLYMORPHISM IN THE SEROTONIN TRANSPORTER GENE

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AIM: To evaluate the relationship between temporomandibular joint dysfunction (TMD) and serotonin transporter (5-HTT) gene polymorphism.
SUBJECTS AND METHODS: Forty-eight patients with TMD and 111 healthy controls. Personal interviews were conducted and blood samples were obtained after a physical examination. The patients were evaluated using the Symptom Checklist 90 Revised, Beck Depression Scale, and State Trait Anxiety Inventory I and II.
RESULTS: The 5-HTTLPR results of the patients and controls were not significantly different ($P > 0.05$). The analysis of genotype distribution, homozygous for STin 2.10 genotypes of the VNTR polymorphism, showed significant differences between the patients and controls ($P = 0.003$). ST 2.10 allele was more frequent in patients with TMD. In the control group, however, STin 2.2/12 genotype was significantly higher than in the patients ($P = 0.017$). In the patients who were homozygous or heterozygous for VNTR variants of 5-HTT STin 2.12 copies, the average scores for somatization and anger were significantly higher than those who were homozygous for STin 2.10 variant ($P < 0.05$). The patients who were homozygous for STin 2.10 genotype were also homozygous for 'L' genotype ($P = 0.019$). However, this was not the condition in the controls.
CONCLUSION: This study does not provide evidence to support the involvement of 5-HTTLPR in TMD. The findings indicate that only the presence of the homozygous STin 2.10 genotype of VNTR is likely to play a substantial role in the genetic of predisposition to TMD, and the STin 2.12/12 genotype may have a protective role against TMD.

107 MANDIBULAR MOVEMENT CAPACITY IN YOUNG ADULTS WITH AND WITHOUT ARTICULATORY SPEECH DISORDERS

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AIM: To investigate whether articulatory speech disorders and malocclusions are related to mandibular movement capacity in young adults.

SUBJECTS: Fifty-two individuals with and 45 subjects without speech disorders (mean age 19.2 years, SD 0.5).
METHODS: The following methods were used: Björk *et al.* (1964) as modified by Laine (1984) for occlusion, Helkimo (1974) and Ettala-Ylitalo (1987) for mandibular mobility and signs of temporomandibular disorders, Remes Articulatory Test (1975) for speech, and Qvarnström (1993) for movements and coordination of the orofacial muscles.
RESULTS: Multiple regression analyses showed that subjects who produced certain speech sounds either too anteriorly or too posteriorly were likely to have a smaller opening capacity than those with correct speech articulation. Increased overjet and distal molar occlusion, as well as lateral crossbite and a tendency to anterior open bite were associated with large movements of the jaw. Asynchrony of condylar movement was related to hypermobility on opening.
CONCLUSIONS: In young adults, mandibular movement capacity seems to vary depending on skeletodental structure and is related to misarticulations of speech, triggered by an inadequate compensation mechanism or poor fine motor control of the neuromuscular system.

108 DENTAL MORPHOLOGY BEFORE AND AFTER ORTHODONTIC TREATMENT OF MESIAL OCCLUSION

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AIM: To distinguish morphological dental dimensions in patients with mesial occlusion, which reliably change during orthodontic treatment.
MATERIALS: Lateral cephalograms and study models of 28 patients aged 13–15 years with mesial occlusion (Angle Class III) before and after treatment with fixed appliances.
METHODS: Standard method of head lateral cephalograms with analysis of 52 dimensions. Dental cast anthropometry and analysis of 22 indices was undertaken together with correlation and multifactorial analyses of cephalogram data and dental casts.
RESULTS: Analysis of the cephalograms showed an increase in posterior face height (S–Go) of 6.7 per cent and lower anterior morphological face height (SNA–Me) of 5.7 per cent. In the upper arch retromolar space (6-PtV) increased to 25.8 per cent and incisor inclination (<1-NL) to 6.4 per cent. The length of the upper dention (Is–ms) decreased to 16.6 per cent. In the lower arch anterior and posterior alveolar tooth height (1-ML, 6-ML) increased 5.4 and 3.7 per cent, respectively. The posterior inclination of the lower first molars increased (< 6-ML) to 10.0 per cent. As a result of changes in the position of the anterior incisors there was a decrease in the interincisor angle (< α) to 2.9 per cent. Dental cast analysis confirmed the index changes of the upper dentition: intercanine distance and the width between premolars increased 6.8 and 4.4 per cent, respectively and the anterior section length increased to 5.1 per cent.
CONCLUSION: During treatment of subjects with mesial occlusion there were reliable changes in the morphological dimensions, in general on teeth and at dentition level, mainly in the upper arch.

109 INTERCEPTION OF UPPER PERMANENT CANINE IMPACTION

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AIM: To evaluate the importance of a correct diagnosis of upper permanent canine ectopia, to prevent possible impaction.
SUBJECTS: The first 50 patients attending for orthodontic treatment in whom the permanent canines were unerupted.
METHODS: Following radiographic and clinical examination the patients were divided into two groups: Group 1, the upper permanent canine in axis with the deciduous, which appeared resorbed; Group 2, the upper permanent canine was positioned mesially with regard to the upper lateral incisor root already erupted. This second group of 16 patients with a total of 18 impacted teeth were further subdivided according to the presence or absence of a canine bulge. In 13 patients with 16 impacted canines there was no appreciable bulge. Ten of these subjects were treated by extraction of the deciduous canine whilst the other three patients chose to await spontaneous change.
RESULTS: The subjects were followed for a period of three years. In all subjects, except one, the maxillary permanent canines erupted. The patient whose impacted canine was unerupted was from the group who had elected not to have the deciduous canine extracted.
CONCLUSIONS: The results show the importance of extraction of primary canines to prevent impaction of the permanent tooth, especially in subjects where the crown radiographically overlaps the root of the permanent lateral incisor.

110 FUNCTIONAL CONDITION OF THE MAXILLOFACIAL MUSCLES BEFORE AND AFTER TREATMENT IN SUBJECTS WITH DISTAL OCCLUSION

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AIM: To study the functional condition of the maxillofacial muscles in children with distal occlusion.
SUBJECTS: Thirty children, 7–12 years of age, with distal occlusion, due to the distal position of the mandible.
METHODS: Electromyographic (EMG) activity of the maxillofacial muscles (temporal, masticatory, suprahyoid) was registered on the EMG 'Medelek' (UK). The time and range of EMG indices, muscle biopotential meanings, time of bioelectric activity and bioelectric rest of muscles, and duration of the masticatory period were studied. As a result, the coefficient of co-ordinated activity in antagonistic and synergistic muscles for masticatory movement and for all masticatory periods was defined.

RESULTS: After orthodontic treatment there was a change in the range of the muscle indices: temporal to 8.9 per cent, masticatory increased to 0.8 per cent, and the suprahyoid group decreased to 12.5 per cent; however, they corresponded to average norms ($P > 0.05$). Biopotential means of the temporal muscles decreased to 5.0 per cent ($P > 0.05$), masticatory to 0.9 per cent ($P > 0.05$), and the suprahyoid group of muscles to 10.3 per cent ($P > 0.05$); however, these changes in comparison with norm were not reliable.
CONCLUSION: The functional condition of the dentofacial muscles using EMG data analysis in patients with distal occlusion after orthodontic treatment shows values corresponding to normal.

111 EFFECTS OF ACID ETCH DURATION ON THE EXTENT OF STRUCTURAL CHANGES IN ENAMEL

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AIM: To assess *in vitro* the extent of superficial and deep structural changes in human enamel during acid etch procedures in relation to etch duration.
MATERIAL AND METHODS: One hundred and thirty-five enamel specimens were prepared by sectioning crowns of extracted sound premolars perpendicular to the long axis. The specimens were divided into groups of 12, and the natural tooth surfaces of each group were etched with 37 per cent orthophosphoric acid for either 15, 30, 45, or 120 seconds. In the second trial, groups of 25 samples were etched either once or twice for 60 seconds with or without application of bonding agent between etching. Subsequently the specimens were examined under confocal laser scanning microscope, TIFF files were generated and the extent of enamel removal from the surface and structural changes below the surface was quantitatively assessed using an image analyser. Statistical analysis included ANOVA, Bonferroni/Dunn, Student's *t*-, and Mann–Whitney ranked sum tests.
RESULTS: The extent of enamel removal from the surface increased significantly between 15 and 30 seconds of etching, but remained unchanged after longer periods. Etching durations above 15 seconds caused substantial changes of enamel structure below the etched surface, reaching 100 gm or more, as shown by image analysis measurements and application of FITC-labelled molecular probes. The depth and extent of subsurface structural changes were significantly related to the length of acid exposure, and corresponded especially to increases of etch duration between 15–30 and 45–60 seconds. The extent of both enamel removal from the surface and subsurface structural changes was higher after repeated etching, but was not influenced by application of bonding agent between etching procedures.
CONCLUSION: Enamel etching for a duration in excess of 15–30 seconds does not contribute to an increase in enamel surface area available for resin retention, whilst it may lead to increased enamel structure damage below the etched surface.

112 RELATIONSHIP BETWEEN TONGUE PRESSURE FORCE AND DYSFUNCTION IN KINDERGARTEN CHILDREN

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AIM: To evaluate the relationship between tongue dysfunction and tongue pressure force in kindergarten children.
SUBJECTS AND METHOD: One hundred and twenty-seven children with healthy deciduous teeth (age 3–6.5 years, 58 females, 69 males). In each child malocclusion and tongue dysfunction were examined. Malocclusion was classified in the usual manner. Classification of tongue dysfunction was performed according to the presence and severity of the following symptoms: contraction of the perioral musculature, tongue pressure during swallowing and speaking the word 'assa' and tongue position in a relaxed situation. These symptoms were classified as light (one symptom present), medium (two to three symptoms present), or strong (all symptoms present). Tongue pressure force was measured in each child (×5 during one day) using the Myometer 160 (MFT Products). Statistical evaluation was performed with the Chi-square and Fisher's exact tests ($\alpha = 0.05$).
RESULTS: Thirty-four children had a maximum tongue pressure below 0.6 p and 45 children showed strong tongue pressure (grade 4–5). Only 10 children (50 per cent) had no tongue dysfunction. There was a statistically significant difference between tongue dysfunction and tongue pressure force, i.e. a low tongue pressure force was related to tongue dysfunction.
CONCLUSION: Children with a strong tongue dysfunction had low tongue pressure force and *vice versa*.

113 REDUCED LOADING ALTERS THE MATRIX METALLOPROTEINASE ACTIVITY OF MANDIBULAR CONDYLAR CARTILAGE

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AIM: To measure experimentally the effects of altered loading of the condylar cartilage on matrix metalloproteinase-3 (MMP-3) activity. MMP-3 is thought to be involved in degradation of cartilage extracellular matrix.
MATERIALS AND METHODS: One hundred female rats were assigned to two groups: the experimental group was fed a soft diet after weaning and the incisors were shortened to keep them out of occlusion. The controls were fed a hard diet. After 10 days the rats were analysed by zymography using casein and gelatine substrates and by immunohistochemical analyses for MMP-3.
RESULTS: All cartilage layers in the soft diet group showed immunostaining against MMP-3. In the control (hard diet)

group the staining was weaker or absent. Casein gel zymography revealed that the MMP-3 represented a prominent 29-kDa active form in the experimental group, indicating active proteoglycan catabolism. In gelatine gel zymography some more gelatinolytic activity could be seen in the soft diet group in the region of 72 kDa, corresponding to the latent form of MMP-2.
CONCLUSIONS: A continuous soft diet and suppressed incisal mastication in the rat is associated with an increase in MMP-3 expression in the condylar cartilage, an enzyme associated with cartilage matrix breakdown. A possible explanation for the increased MMP-3 levels and activation can be a physiological breakdown of excess cartilage matrix, due to less occlusal function.

114 MANDIBULAR AUXOLOGY CATEGORY IN ITALIANS WITH CLASS II MALOCCLUSIONS

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AIM: To evaluate the prevalence for each of six auxology categories in a group of Italian subjects with Class II malocclusions.
SUBJECTS AND METHOD: Two hundred and eighty subjects (133 males, 147 females), aged from 7.8 to 13 years (mean 9.25 ± 1.5 years), with dental and skeletal Class II malocclusions. Standard lateral skull radiographs were taken and the following cephalometric angular variables were measured: SNA, SNB, ANB, NL–NSL, ML–NSL, NL–ML according to Hasund. Mean and standard deviation were calculated. In order to evaluate the mandibular auxology category for each subject, T1, T2, and T3 were determined according to Lavergne and Petrovic.
RESULTS: The following mean values were found: SNA = 81.1°; SNB = 75.3°; ANB = 5.8°; NL–NSL = 8.5°; ML–NSL = 35.5°; NL–ML = 27°; NSBa = 131.6°. Thirty-one subjects showed auxology category 1 (11 per cent), 44 category 2 (15.7 per cent), 80 category 3 (28.6 per cent), 28 category 4 (10 per cent), and 97 category 5 (34.7 per cent). No subject had an auxology category 6.
CONCLUSIONS: The sample showed an orthognathic facial type, and a harmonious sagittal and vertical position of the maxilla relative to cranial base, whereas the mandible seemed to be retruded and/or posteriorly rotated. Since a disharmony in mandibular prognathism and/or inclination is the most consistent finding, a mandibular advancement might be advised in order to correct the malocclusion. The higher auxology category the more the mandible shows growth potential and responsiveness to treatment. Functional appliances may be effective in categories 3, 4, and 5, i.e. most patients (73.3 per cent) in a mixed-dentition Italian population with Class II malocclusions.

115 AETIOLOGICAL CEPHALOMETRY FOR OBSTRUCTIVE SLEEP APNOEA SYNDROME

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AIM: In obstructive sleep apnoea (OSA), cephalometry is usually used for diagnosis. The purpose of this prospective study was to investigate a model for apnoea/hyponoea (AH) based on some selected variables concerning hard tissues, body mass index, and age.
SUBJECTS AND METHODS: Ninety patients with suspected OSA were recruited (polysomnography in a sleep laboratory, ORL examination, cephalometry). Discriminant cephalometric variables for pathologies with apnoeas and hyponoeas were chosen: TPS, K Ba, PNS, SP. Two angles were defined, APA and APP, to diagnose a collapse in the lower or higher pharynx.
RESULTS: The new cephalometric points were significantly similar to those used in the diagnosis of OSA. Norms were established. Because some variables were correlated, only Pmx, Pmd, APA, APP, and TPS-M were selected for backward elimination procedure for dependent variable AH. A linear function (R^2 per cent = 045) was defined to predict AH.
CONCLUSIONS: This original method to analyse radiographs of OSA patients is quick and simple. The predisposition to develop OSA was clearly defined, and the model would be clinically useful as a screening tool for OSA in a selected consultation. However, other aetiological factors should be considered.

116 ENDOSCOPICALLY ASSISTED ADJUSTMENT OF AN ORAL APPLIANCE IN PATIENTS WITH OBSTRUCTIVE SLEEP APNOEA

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AIM: To examine the changes in the pharyngeal airway at different extensions of mandibular protrusion in patients suffering from obstructive sleep apnoea (OSA) in order to assess the therapeutic effect at the optimal sagittal position of the lower jaw.
SUBJECTS AND METHODS: Twelve male patients (mean age: 48.3 years, mean body mass index: 27.3 kg/m^2) with the polysomnographic diagnosis of a mild to moderate OSA. A nasal video endoscopy of the pharynx was performed. The protrusion of the mandible was altered using an adjustable appliance (Silencer®). Images were obtained during inspiration and expiration at 2, 5, and 8 mm of mandibular protrusion relative to centric occlusion. The area of the airway at the oropharyngeal level was planimetrically determined. After 3–4 weeks a control

polysomnography was performed with the mandible in optimal protrusion.
RESULTS: The pharyngeal diameter increased from 4 per cent at a mandibular protrusion of 2 mm, to 24.2 per cent at a protrusion of 5 mm and 26.7 per cent at a protrusion of 8 mm. In the polysomnographic examination the mean apnoea–hypopnoea index was reduced from 20.8 ± 9.2/h to 8.2 ± 4.7/h, the apnoea index from 9.2 ± 8.1/h to 4.3 ± 2.5/h and the mean oxygen desaturation from 19.8 ± 15.9 per cent to 12.8 ± 7.2 per cent at the optimal mandibular position. None of the patients was classified as a non-responder to the appliance therapy.
CONCLUSION: Endoscopically assisted adjustment of a mandibular protrusion appliance is an additional tool to optimize the treatment of OSA patients. The increase in pharyngeal diameter is not proportional to the amount of protrusion of the mandible. Further studies are needed to prove that this type of examination improves the clinical outcome.

117 CEPHALOMETRIC EFFECTS OF INCISAL DOUBLE CAPPING ACTIVATOR THERAPY

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AIMS: To determine differences in cephalometric measurement before and after activator treatment in children with skeletal Class II malocclusions caused by mandibular retrognathism.
SUBJECTS: Twenty children (10 boys, 10 girls) with Class II division 1 malocclusions without a history of prior orthodontic therapy. The mean age at the start of treatment was 9 years. The ANB angle was on average 6.86 degrees and the overjet 9.43 mm. All patients had a retrognathic mandible (SNB 74.43).
METHODS: An incisal double capping activator was used in all subjects. The mandible was protruded to reach an edge-to-edge incisor relationship. The patients were instructed to wear the appliance a minimum of 14 hours in each 24-hour period. For each patient a lateral cephalogram was taken before (T0) and 18–24 months after (T1) treatment.
RESULTS: Treatment of Class II malocclusions in growing patients with an activator can be expected to result in: correction of the Class II relationship (ANB: 2.64); correction of overjet (–4.71); uprighting of the maxillary incisors (1^ SN: –6.36); reduced advancement of maxillary point A (SNA: –1.71°) and increased advancement of mandibular structures (OPLp-B +3.43, OPLp-Me +3.93, OPLpPg +3.78, OPLp-Go +1.28).
CONCLUSION: Activator therapy improves Class II malocclusions by a combination of skeletal and dental changes and improves the soft tissue facial profile.

118 WHERE ARE THE REAL LOCATIONS OF THE CANINES IN THE DENTAL ARCHES?

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AIM: To investigate whether the positions of the canines and molar teeth are normal or abnormal according to their ideal dental arch positions.
MATERIAL AND METHOD: Dental casts of 26 subjects with increased arch length discrepancies were constructed. Initially, the tips of the canine and mesiobuccal molar tubercules were marked on the dental casts. These measurements constituted the first study group. In the second phase, ideal arch forms were constructed according to the dental dimensions of each subject. The same dental points were then marked on these ideal arch forms. As a general approach, intercanine and intermolar dimensions, anterior and posterior arch depths, and the ratios of these measurements were used. Eight dimensions and six proportions were made in each study group. Finally, initial and final measurements were compared and differences were determined statistically by a paired *t*-test.
RESULTS: Maxillary intermolar dimensions and maxillary canine/molar ratios were similar in each group. Inter-group differences were not significant. Intercanine and mandibular intermolar dimensions, anterior and posterior arch depths, and other anterior ratios were different in each group. In the second group anterior arch depth was shorter. In the dental arches with crowding, almost all dimensions decreased when compared with their ideal arch forms. Canine and molar teeth were generally situated in a more anterior position.
CONCLUSION: Although the canine teeth were buccally positioned in the first group, the intercanine width was narrower than ideal.

119 CEPHALOMETRIC EVALUATION OF RAPID ANTERIOR MAXILLARY EXPANSION

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AIM: To evaluate the changes that occur due to rapid anterior expansion of the maxilla with a hyrax fan-type expansion screw, using cephalometrics and study models.
SUBJECTS: Eleven patients (7 females, 4 males) with a mean age of 17.5 years. All patients had an anteriorly constricted maxillary arch, no crossbite in the posterior region, mild to moderate crowding in the upper anterior segment, and were in the permanent dentition.
METHODS: For appliance construction, a hyrax fan-type screw was soldered to bands on the upper first premolars and molars. Following cementation of the appliance, the patients were instructed to turn the screw twice a day (quarter turn each). Expansion lasted 2–6 weeks (mean 3 weeks). The patients were retained with the same device for three months. Measurements made on postero-anterior and lateral cephalograms and study models taken before, after

expansion and at the end of retention period were statistically evaluated by a *t*-test.
RESULTS: The first premolar area showed the greatest amount of expansion (8.95 mm, $P < 0.05$). It was followed by intercanine and intermolar widths (2.91 and 2.68 mm, respectively, $P < 0.05$). The upper incisors were slightly uprighted and extruded (0.75 mm) at the end of the retention period. The maxilla moved downward and forward (Nper-A 0.75 mm, $P < 0.05$). The upper first molars rotated mesiobuccally. Arch perimeter increased remarkably (3.68 mm, $P < 0.05$). The mandible rotated slightly clockwise and lower face height increased at the end of retention.
CONCLUSION: Rapid anterior expansion of the maxilla with a hyrax fan-type screw is effective in broadening the smile especially in patients with maxillary anterior restriction; however, it is advisable to be cautious when using this device in patients who present a high angle growth pattern.

120 HOLDAWAY MEASUREMENT NORMS IN TURKISH ADULTS

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AIM: To establish cephalometric norms for Turkish adults using Holdaway's analysis and to investigate sexual differences between Turkish female and male subjects.
MATERIAL AND METHODS: One hundred cephalometric head films of 50 adult females and 50 adult males. The subjects were over 18 years of age, with parents of Turkish origin, an acceptable facial structure, ideal dental occlusion, no visual or hearing disorders, and with a complete dentition, with the exception of third molars. No subject had undergone orthodontic treatment or orthognathic surgery, burns, injuries, cicatrix tissue in the head and neck regions, or breathing and swallowing disorders. Measurement of the hard and soft tissues was carried out on lateral cephalometric radiographs taken in the natural head position. The measurements were evaluated using the Minitab statistics program. The range, means, standard deviations, and standard error of means of the measurements were calculated for both males and females. The effects of sex were investigated using a Student's *t*-test.
RESULTS: The nose prominence measurement at a level of 0.05 and the measurements of basic upper lip thickness, upper lip thickness, inferior sulcus to H line, and soft tissue chin thickness reflected changes due to gender.
CONCLUSION: The upper lip, nose, and chin thickness in males is more protruded than in females.

121 HEAD POSTURE AND HYOID BONE POSITION IN ADULT FEMALES AND MALES

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AIM: To investigate head posture and hyoid bone position on cephalometric radiographs of adult females and males.
MATERIAL AND METHODS: Seventy-six cephalometric head films of 38 adult females and 38 adult males taken in the natural head position (NHP). The individuals were over 18, with parents of Turkish origin, acceptable facial structure, ideal dental occlusion, and ANB 1–5 degrees. They had no visual or hearing disorders and had all the teeth present except the third molars. No subject had undergone orthodontic treatment or orthognathic surgery, burns, injuries, cicatrix tissue in the head and neck regions, or breathing and swallowing disorders. In order to determine NHP, the subjects were requested to stand at rest in a relaxed manner, the so-called 'self-balance position'. This position was then transferred to the cephalostat by means of a fluid level device. The effects of sex on the measurements were investigated by means of a Student's *t*-test using SPSS (Windows 7.5).
RESULTS: Measurements used in the determination of NHP were not affected by sex. The linear measurements regarding the position of hyoid bone, H-CV4ia, H-CV4ip, H-CV3ia, H-CV2ia, H-Bo, H-Ar, HM-S, H-ANS, H-RI, H-CVT, H-NSL, H-NL, H-ML and G-HB, H-BC, HG-B angle of the position of hyoid bone measurements showed statistically significant differences with respect to sex.
CONCLUSION: NHP is not affected by sex differences; however, in females hyoid bone position is higher and more backward than in males.

122 CLINICAL COMPARISON OF FLUORIDE RELEASING VERSUS CONVENTIONAL ELASTOMERIC TIES AROUND BONDED BRACKETS

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AIM: To determine whether ligating orthodontic brackets with fluoride releasing elastomeric ties (FRET) reduce white spot formation compared with conventional elastomeric ties (CET).
SUBJECTS: Twenty patients (13–15 years of age) all with a Class I malocclusion in whom fixed appliance treatment involving extraction of four first premolars was being undertaken.
MATERIAL: Eight FRET and eight CET were placed in a cross-quadrant fashion in each subject on their orthodontic attachments from second premolar to second premolar in both maxillary and mandibular arches. The ligature ties were changed monthly throughout the course of the study. At the end of active orthodontic treatment removal of the brackets was carried out with debonding pliers. The severity of the decalcified area was scored on a scale of 0 to 3.
RESULTS: Enamel decalcification was found in four teeth on the FRET side (2.5 per cent) and in 16 teeth on the CET side (10 per cent). These results were significant ($P < 0.05$). Two of the four decalcified teeth on the FRET side belonged to one subject who also showed five decalcified teeth on the CET side. All teeth showing decalcification were regarded as grade 1.
CONCLUSION: FRET may offer significant caries protection around bonded brackets independent of patient co-operation.

123 SKELETAL OPEN BITE TREATMENT IN SHEEP USING DISTRACTION OSTEOGENESIS

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AIMS: To investigate the use of distraction osteogenesis to vertically close posterior open bites.
MATERIALS AND METHOD: Seven sheep were placed under intravenous general anaesthesia using pentobarbital. An incision was made and the mucosa was reflected exposing the lateral surface of the mandible. A 5 mm posterior skeletal open bite was created on one side of the mandible in each sheep. Following completion of the osteotomy, a device was inserted to allow the segmented parts to be vertically distracted. The sheep received two million units of procaine penicillin for five days and were fed a softened diet for the period of the study. The distraction device was not activated for seven days to allow for periosteal healing and early revascularization. The mandible was distracted superiorly 0.5 mm twice a day for 10 consecutive days. After closing the posterior open bite the device was stabilized.
RESULTS: Radiographic examination after 10 weeks of healing showed that bone had formed between the distracted segments closing the posterior skeletal open bite.
CONCLUSION: Distraction osteogenesis has potential for use in the treatment of skeletal open bites. Further investigations are required to determine whether bone augmented by this method will be able to withstand the forces of mastication.

124 THE EFFECT OF FLUORIDE RELEASING ELASTOMERIC TIES ON *STREPTOCOCCUS MUTANS* IN DENTAL PLAQUE AROUND ORTHODONTIC BRACKETS

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AIM: To evaluate the effect of fluoride releasing elastomeric ties (FRET) on *Streptococcus mutans* in dental plaque around orthodontic brackets.
SUBJECTS: Ten male patients ranging in age from 14 to 16 years participated voluntarily in this investigation.
MATERIALS: Each patient had 10 FRET and 10 conventional elastomeric ties (CET) placed in a cross-quadrant fashion on their orthodontic attachments from second premolar to second premolar in the maxillary and mandibular arches. Plaque samples were taken from the buccal surface around the orthodontic brackets daily for three days and then weekly for six weeks after bonding. On removal they were transferred to the laboratory within 2–3 hours for *Streptococcus mutans* isolation.
RESULTS: The percentage of *Streptococcus mutans* in dental plaque decreased significantly more in the FRET than in the CET group during the first four weeks of intra-oral use. No significant effect was found for the FRET after it had been in place for more than four weeks.
CONCLUSION: FRET reduces the level of *Streptococcus mutans* in dental plaque and so reduces the chances of enamel decalcification around orthodontic brackets. For optimal clinical benefit, FRET should be replaced after four weeks of intra-oral use.

125 TREATMENT OF DIFFERENT TYPES OF CLASS II MALOCCLUSIONS WITH AN ACTIVATOR

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AIM: To investigate changes in the craniofacial system of children in the early mixed dentition with a Class II malocclusion treated with an activator appliance.
SUBJECTS: Eighteen boys and 22 girls, with a mean age of 8 years 4 months.
METHOD: Teleroentgenographic analysis was performed before and two years after the start of treatment. The subjects were divided into two groups, one with Class II division 1 and the other with Class II division 2 malocclusions. Anterior growth rotation was detected in both groups.
RESULTS: In children with a Class II division 1 malocclusion, use of an activator resulted in retrusion of the maxillary incisors, movement of the mandible in a vestibular direction, slight enlargement of the mandibular body as well as mild intrusion of the maxillary incisors. In Class II division 2 subjects the maxillary incisors were protruded, the lateral incisors were retruded and the mandibular incisors protruded. The mandible was moved in a vestibular direction and vertical growth of the mandibular premolars and molars was found.
CONCLUSION: In the early mixed dentition in patients with anterior growth rotation use of an activator of adequate construction can achieve very good results in subjects with both Class II division 1 and 2 malocclusions.

126 VERTICAL FACIAL FORM AND THE CAPILLARY BED OF THE HUMAN MASSETER MUSCLE

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AIM: Capillition of muscle is related to its fibre type composition and fibre cross-sectional area, which are related to the functional demands placed upon the muscle. Differences in the fibre composition of the masseter muscle have been noted in normal vertical facial form (VFF) and long face syndrome (LFS) subjects and have been attributed to differences in function. The aim of this study was to compare the magnitude and distribution of the capillary bed

of the human masseter muscle in relation to fibre type parameters in normal VFF and LFS subjects.
MATERIALS AND METHOD: Twenty masseter muscle biopsies were categorized into 10 normal VFF and 10 LFS subjects using cephalometric analysis. Capillaries and fibre types were identified using immunohistochemistry and appropriate capillary and fibre parameters were measured (see table). Group and class means were compared using the Newman-Keuls multiple comparison test.

	Slow Fibres		Intermediate Fibres		Fast Fibres	
	Normal	LFS	Normal	LFS	Normal	LFS
Capillaries around fibres	2.53	2.45	1.99	1.79	1.31	1.10*
Fibre density (mm^2)	173	157	183	155	100	50*
Cross-sectional area (μm^2)	1780	2172	1377	1408*	804*	675*
Fibre proportions (%)	37	42	40	44	22*	13*

*$P = 0.05$.

RESULTS: Capillary density was similar in both groups of subjects. There was no correlation between cephalometric variables and capillation of muscle fibres. Capillation of all types of fibres was proportional to fibre cross-sectional area and fibre phenotype.

127 EFFECTS OF SERIAL EXTRACTION TREATMENT ON CRANIOFACIAL MORPHOLOGY

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AIM: To evaluate the effects of serial extraction treatment on craniofacial morphology.
SUBJECTS AND METHODS: Treatment group: 16 individuals (7 girls, 9 boys) whose arch length discrepancies were 7 mm or more and who were treated with first premolar serial extractions. Control group: 16 individuals (7 girls, 9 boys) who had not undergone orthodontic or orthopaedic treatment and were similar to the extraction group according to age, sex, skeletal maturation, and craniofacial morphology. All subjects exhibited an Angle Class I molar relationship. The average treatment and control period was 3 years 3 months. The study was carried out on lateral cephalograms taken at the beginning and end of treatment or control periods. The SN plane of the first film was transferred to the second film and craniofacial measurements were performed. The intra-group changes in both treatment and control groups were examined by paired *t*-tests. Comparisons between the groups according to the changes were evaluated by Student's *t*-tests.
RESULTS: The upper incisor/SN angle decreased in the treatment group but increased in the control group. There was a statistically significant difference between the groups according to the changes in this angle ($P < 0.05$). In the treatment group, the upper molars moved in a more forward direction compared with the control group ($P < 0.05$). The changes observed in the craniofacial structures were not significant between the treatment and control groups.
CONCLUSION: The space gained by serial extractions was used for the elimination of crowding, retrusion of upper and lower incisors, and mesialization of upper and lower molars. No significant changes were observed in craniofacial structure.

128 TREATMENT OF CLASS II DIVISION 1 MALOCCLUSIONS WITH AN ACTIVATOR: A CEPHALOMETRIC STUDY

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AIM: To assess skeletal and dental changes produced by activator therapy in growing children with Class II malocclusions.
SUBJECTS AND METHODS: Forty children with Class II division 1 malocclusions. The sample was divided into two groups: 20 patients (10 males, 10 females) were treated with an activator, and 20 patients (9 males, 11 females) served as the control. The mean age at initial cephalograms was 10.6 years in the treated group and 10.5 years in the controls. The treatment and observation period was two years. Lateral cephalograms, obtained before and after the study period, were traced and 17 variables (5 linear and 12 angular) were measured. A paired *t*-test was used to compare the results of pre- and post-treatment cephalometric analysis.
RESULTS: The skeletal effects of the activator were small (no statistical differences were found between treated and control group for SNA, SNB, SNPg). The ANB angle decreased during treatment by approximately 0.5 degrees. During treatment the overjet was reduced by 2.30 mm, mostly by retroclination of the upper incisors (about 3 degrees) and slight proclination of the lower incisors. The activator produced a slight backward rotation of the mandible.
CONCLUSION: Activator therapy in patients with Class II division 1 malocclusions has only dental effects and does not seem to affect the position and size of upper and lower arch.

129 BIONATOR WITH SPIKES— A SUPPLEMENT TO FUNCTIONAL TONGUE THERAPY

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AIM: To determine whether tongue dysfunction can be treated with a combination of a Bionator with spikes.

SUBJECTS AND METHODS: A Bionator with spikes was used by 113 patients (65 boys, 48 girls) who had completed active orthodontic therapy. The lingually directed spikes, 6–7 mm long, made of 0.7–0.8 feather-hard stainless steel, were fabricated to fill the anterior side from canine to canine. The apparatus should be worn for nine hours every night and 5–6 hours during the day.
RESULTS: Without exception, all subjects reported that they had not felt the spikes after one week. Seven patients had slight bleeding of their tongues on the first two days after appliance insertion but did not feel this was a problem. The patients reported a change in tongue position at the first control visit. Nine subjects who were resistant to therapy had a very strong vertical or progenic growth. After a period of of 6–9 months the Bionator, or the spikes on it, was removed. During follow-up examinations after 3–6 months a stable tongue position was established, without exception, in patients for whom the readjustment had been successful.
CONCLUSION: Over a period of 1–1½ years, there was no recurrence of the pre-existing tongue dysfunction, indicating that the Bionator with spikes could be a useful supplement to myofunctional therapy.

130 ASSESSMENT OF THE DENTITION IN CHILDREN EXPOSED TO RADIATION

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AIM: To determine the functional condition of the dentition in children exposed to radiation influence.
MATERIALS: One hundred and three subjects aged 7–17 years, living in Novozybkov town, Bryansk area, with radiation polluted soil by Cs-137 from 15 to 45 Ku/km^2. The children were divided into two groups: those born before (group 1) and those born after (group 2) the explosion at the Chernobyl nuclear power station.
METHODS: All subjects were clinically examined using the standard masticatory trial test (hazelnut-800 mg). The duration of the masticatory period and the quantity of masticatory movement were registered and compared with reported norms (Persin *et al*., 1981).
RESULTS: The condition of the dentition corresponding to age norms was determined from the whole number of examined children in 6.8 per cent of cases. Dental abnormalities were found in 17.49 per cent, occlusal abnormalities in 26.23 per cent, overbite in 19.43 per cent and reduced overbite in 6.8 per cent of subjects. Associated dental and occlusal abnormalities were found in 61.12 per cent. All children living in the radiation polluted areas born before and after the explosion at Chernobyl had an increased masticatory period with the quantity of masticatory movement corresponding to average norms of 8.3–127.3 per cent.
CONCLUSION: The quantity of masticatory movement in group 2 was l.1–1.4 greater than in group 1. In group 2 the time of the masticatory period with physiological norms and occlusal abnormalities increased 1.2 times compared with group 1.

131 XENON ARC LIGHT-CURING OF ADHESIVE PRECOATED AND UNCOATED BRACKETS

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AIM: To evaluate the shear bond strengths of adhesive precoated brackets (APC) and conventional uncoated brackets cured with two different light-curing units: a conventional visible light and a xenon arc light.
MATERIALS AND METHODS: Sixty freshly extracted bovine permanent mandibular incisors were randomly divided into four groups, each consisting of 15 specimens. Two different types of brackets were evaluated: conventional uncoated brackets (Victory) and APC. Two groups (one for each type of bracket) were exposed to the visible light (Visilux 2) for 20 seconds and used as controls. The remaining two groups, again one for each type of bracket, were cured with the xenon arc light (Aurys) for two seconds. After bonding, all samples were stored in distilled water for 24 hours and subsequently tested in a shear mode with an Instron machine. Statistical analysis (two-way ANOVA, Scheffé's, and Chi-square tests) was performed.
RESULTS: The shear bond strength of the uncoated brackes cured with Visilux 2 was significantly higher than of all the other groups tested. Both groups cured with Visilux 2 produced significantly higher bond strengths than those of the corresponding groups cured with Aurys. No statistically significant differences were found between the two groups cured with Aurys.
CONCLUSIONS: Compared with visible light-curing, the xenon arc light enables clinicians to significantly reduce the curing time of both APC and conventional brackets and, although significantly lower, their shear bond strengths are still clinically acceptable.

132 CRANIOFACIAL PATTERNS IN CHILDREN WITH DYSTROPHIC EPIDERMOLYSIS BULLOSA RECESSIVA

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AIM: To examine the craniofacial pattern of patients diagnosed with dystrophic epidermolysis bullosa recessiva (DEBr).
MATERIALS: Lateral skull radiographs of 42 patients (25 males, 17 females) diagnosed with DEBr were examined. The analyses were based on the Jiffy Orthodontic Evaluator (Version 4.0, Rocky Mountain Orthodontics, San Francisco, USA); an error study was undertaken on 10 pairs of

radiographs. In addition, the differences between patients with normal cephalometric values were assessed and compared (without consideration for ethnicity).
METHOD: Lateral skull radiographs were digitized and a number of orthodontic indices were compared with published normal values.
RESULTS: These are shown below:

Variable	Normal values Mean (s.d.)	DEBr values Mean (s.d.)	
Maxillary length (mm)	47.4 (2.5)	41.3 (2.9)	***
Mandibular length (mm)	93.1 (4.2)	82.3 (6.1)	***
Middle facial height (mm)	65.2 (2.4)	54.1 (5.7)	***
Lower facial height (mm)	56.5 (3.5)	42.7 (4.9)	***
Lower lip to aesthetic plane (mm)	2.6 (0.4)	–2.6 (4.3)	***
Nasio-labial angle (degrees)	110.1 (1.1)	141.1 (16.4)	***
Saddle angle (degrees)	130.7 (0.8)	123.7 (9.8)	***

***$P < 0.001$.

CONCLUSION: The reduced calorie intake and scar tissue appear to modify the craniofacial form in patients diagnosed with DEBr.

133 NEOVASCULARIZATION IN THE TEMPOROMANDIBULAR JOINT IN RESPONSE TO MANDIBULAR PROTRUSION

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AIM: To examine neovascularization in the temporomandibular joint (TMJ) in response to mandibular forward positioning.
MATERIAL: Thirty-five-day-old Sprague–Dawley female rats were divided into five experimental and five control groups. Functional appliances were fitted to the upper incisors of animals in the experimental groups, causing a continuous mandibular protrusion. The animals in the experimental groups, together with their matched controls, were sacrificed 3, 7, 14, 21, and 30 days after mandibular protrusion, respectively.
METHODS: Sections, 7 μm, were cut through the TMJ and processed for immunohistochemical analysis. Neovascularization was assessed by immunostaining for endothelial cells using monoclonal antibody EN 7/44. Immunolocalization of neovascularization was quantified using the Leica Qwin system.
RESULTS: (1) In the fibrous tissue connecting the posterior aspects of both the condyle and the glenoid fossa, the amount of immunostaining for neovascularization in the experimental groups was on average, 200 per cent higher than in the controls ($P < 0.001$); (2) in the condylar bony tissue, as well as in the bony tissue of the fossa, the amount of immunostaining for neovascularization in the experimental groups was on average 103 to 163 per cent higher, respectively, than in the controls ($P < 0.001$).
CONCLUSION: Neovascularization in the TMJ increases in response to mandibular protrusion, which could be a major contributing factor to increased new bone formation in the TMJ.

134 EXPRESSION OF VASCULAR ENDOTHELIAL GROWTH FACTOR IN THE GLENOID FOSSA DURING MANDIBULAR PROTRUSION

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AIM: To identify the temporal expression of vascular endothelial growth factor (VEGF) in the glenoid fossa in response to forward mandibular positioning.
MATERIALS AND METHODS: One hundred and fifty female 35-day-old Sprague–Dawley rats randomly divided into 10 experimental groups (10 rats per group) and 10 control groups (5 rats per group). The experimental groups were fitted with functional appliances that positioned the mandible in a continuous forward posture. The rats were then sacrificed after 3, 14, 21, 30, 33, 37, 44, and 60 days, respectively. Sections, 7 μm, were cut through the glenoid fossa at the sagittal plane and stained with anti-VEGF antibody to evaluate the amount of VEGF expression.
RESULTS: The expression of VEGF reached its highest on day 14 in the experimental groups and on day 21 in the control groups. The highest expression of VEGF occurred in the posterior part of the glenoid fossa in both groups.
CONCLUSION: Continuous mandibular forward positioning results in acceleration of VEGF expression in the glenoid fossa. VEGF expression is enhanced in the posterior part of the glenoid fossa during mandibular protrusion.

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135 INDICATIONS FOR ORTHODONTIC TREATMENT OF PATIENTS AFTER STOMATOGNATHIC TRAUMA

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AIM: To determine the indications for orthodontic therapy during multidisciplinary treatment of patients after stomatognathic trauma.

SUBJECTS: Fifty-two patients (22 females, 30 males) aged 3–14 years. The trauma was located in the temporomandibular joint (TMJ) (l6 cases), the alveolar process (8 cases) and the dentition (40 cases: deciduous teeth 12, permanent teeth 28). The patients were referred to the clinic directly or after surgical treatment.
METHODS: Before orthodontic treatment a clinical examination was carried out and diagnostic records obtained (dental casts, radiographs, if required, and photographs). The reason for treatment of patients with TMJ trauma was to rehabilitate the articulomuscular system and treat the co-existing malocclusion using removable and fixed appliances. In subjects with trauma to the alveolar process or dentition, orthodontic treatment of their malocclusions was undertaken followed by observation of the traumatized and reimplanted teeth. In patients whose teeth were lost during the trauma, orthodontic treatment was carried out prior to prosthodontics (dentures, implants).
RESULTS: In 13 patients with TMJ trauma, normal function was restored. Three patients who discontinued treatment developed TMJ ankylosis (2 osteoankylosis, 1 fibrous ankylosis) and were referred for surgical treatment. Three patients lost the reimplanted teeth: resorption of the traumatized teeth occurred in one subject and one patient developed root canal obliteration. In 40 growing patients with avulsion, orthodontic treatment was undertaken prior to prosthetics.
CONCLUSIONS: Following severe trauma, a multidisciplinary treatment approach is necessary. Growing patients require a longer period of orthodontics before prosthetic treatment.

136 DENTAL CROWDING AND ITS RELATIONSHIP WITH PERIODONTAL DISEASE

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AIM: To investigate the role of dental crowding as a possible aetiological factor for the clinical appearance of periodontal disease.
SUBJECTS: One hundred random patients with dental crowding were compared with a group of 30 subjects with normal occlusion. The ages of the subjects in both groups was 10–14 years.
METHOD: Diagnosis was obtained by routine clinical methods: anamnesis, intra-oral examination and gnathometric analysis on casts. To evaluate oral hygiene and periodontal health, dental plaque staining tests and clinical and radiographic examination for early signs of periodontal disease were undertaken in both groups. Mann–Whitney–*U*, Spearman, and Student's *t*-test were used for statistical evaluation.
RESULTS: No correlation was found between crowding and periodontal disease. Statistical significance was determined only for the dental calculus index. Nevertheless, the mean values of all indices for periodontal health and dental plaque, except that for bone resorption, were higher in the study group compared with the controls.
CONCLUSION: There was no correlation between the investigated parameters, indicating that other factors play a more important role in malposition, but this may be due to lack of precise criteria for definition of malalignment.

137 THREE-DIMENSIONAL FINITE ELEMENT ANALYSIS OF INTRUSION OF UPPER ANTERIOR TEETH

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AIM: To investigate the change of the centre of resistance (CR) and the distal traction force according to alveolar bone height on intrusion of upper anterior teeth using a three-piece base arch appliance.
MATERIAL: Three-dimensional finite element models of six upper anterior teeth, the periodontal ligament, and alveolar bone.
METHODS: On intrusion of the upper anterior teeth, using a three-piece base arch appliance, evaluations were undertaken of the locations of the CR according to the number of teeth, the change of distal traction force for pure intrusion and the correlation with the change in the vertical and horizontal location of the CR according to alveolar bone loss.
RESULTS: As the number of teeth contained in the anterior teeth group increased the CR shifted distally. Regardless of alveolar bone loss, the distal traction force of two and four anterior teeth was lower than six teeth. As alveolar bone loss increased, the distal traction force of each group of teeth was increased. As the number of teeth increased, the CR according to the alveolar bone loss showed a tendency to decrease. As alveolar bone loss increased, the horizontal position of displacement to the vertical position displacement of the CR was increased regardless of the number of teeth.
CONCLUSION: To minimize a secondary effect and to achieve pure intrusion of the upper anterior teeth, the direction of intrusion and biomechanical concepts, as well as the intrusion force must be considered.

138 SHEAR BOND STRENGTH OF DISINFECTED POLYOXYMETHYLENE BRACKETS—A BOVINE ENAMEL STUDY

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AIM: To compare the shear bond strength of polyoxymethylene (POM) brackets (Brillant Brackets®, Forestadent) inlaid in different disinfectants.

MATERIALS AND METHODS: The bovine teeth were stored in 0.2 per cent thymol solution and cleaned with pumice stone before bonding. One hundred and twenty-five POM brackets were divided into five groups containing at least 25 brackets. The brackets were disinfected using the following solutions: group (2) chlorhexidine; group (3) Meliseptol®; group (4) 70 per cent ethanol; group (5) 3 per cent sodium hypochlorite (NaOCl) and group (6) 3 per cent hydrogen peroxide. Group 1 served as the control. Group comparison was confirmed with the *post hoc* test. The level of significance (alpha adjusted) was $\alpha = 0.001$. After etching, the POM brackets were bonded to the bovine enamel with a no-mix adhesive (Quick Bond®, Forestadent). The samples were fixed in epoxy resin and the shear bond strength was measured with an Instron machine.
RESULTS: Disinfection had a significant influence on shear bond strength especially when sodium hypochlorite was used ($P = 0.001$) but not with the use of chlorhexidine ($P = 0.5$). Meliseptol® weakened the shear bond strength, while ethanol and hydrogen peroxide strengthened it ($P = 0.01$).
CONCLUSIONS: As the bond strength of brackets disinfected with NaOCl is low, bracket failure rates in clinical use would be high. For clinical acceptance, chlorhexidine would be a suitable preparation for disinfection of POM brackets.

139 STERILITY TESTS OF POLYOXYMETHYLENE BRACKETS, PRIMER, AND ADHESIVE

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AIM: To evaluate the sterility of polyoxymethylene (POM) brackets (Brillant Brackets®, Forestadent) as supplied by the manufacturer.
MATERIALS AND METHODS: Nine separate POM brackets were randomly taken from three different packages under sterile conditions and each bracket base was placed with slight pressure on a Columbia blood agar plate. The agar plates were incubated for 7 days at a temperature of 36 ± 1°C (5–10 per cent CO_2). The brackets were then placed in enrichment broth (brain-heart-glucose-broth) and incubated for 14 days. The same method was used for the primer and adhesive. In addition, a growing inhibition test was carried out for all three materials. Three brackets, primer, and adhesive were placed under sterile conditions on a diagnostic sensitivity test agar plate (Bacto, DIFCO Laboratories), which was inoculated with *Bacillus subtilis* (ATCC 6633) and *Staphylococcus aureus* (ATCC 25925).
RESULTS: No bacterial growth was found on the culture medium after 7 days incubation. In addition, the control in the stock medium was negative. No bacterial growth was found in relation to the adhesive components. After 24 hours incubation, bacterial growth of *Bacillus subtilis* was markedly inhibited and *Staphylococcus aureus* was weakly inhibited.
CONCLUSION: POM brackets, primer, and adhesive proved to be sterile when taken from the 'as received' package. The POM brackets did not influence the bacterial cultures. Both primer and adhesive were found to have an inhibiting effect on bacterial growth.

140 DENTAL SPLINTS AND CONTINUOUS POSITIVE AIRWAY PRESSURE IN OBSTRUCTIVE SLEEP APNOEA—A RANDOMIZED, CROSS-OVER STUDY

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AIMS: To compare the efficacy of mandibular advancement splints (MAS) and nasal continuous positive airway pressure (CPAP) in subjects with mild or moderate obstructive sleep apnoea (OSA) using a cross-over study design.
SUBJECTS: Twenty male and four female healthy, dentate adults with mild or moderate OSA [apnoea/hypopnoea index (AHI) between 10 and 49].
METHOD: Following diagnosis, the patients were randomized to begin treatment with either MAS or CPAP and the first appliance was fitted. The subjects were seen after 2 weeks and any adjustments necessary for comfort or efficacy were made. After a 2-week wash out period the second device was fitted. Each intervention lasted two months. At the beginning of the study and after each arm of treatment, polysomnography was undertaken and patient and partner questionnaires completed. Treatment success was defined as wearing the device for two months and an AHI of less than 10 at the end of that part of the study. No treatment order effects were found and Friedman's two-way analysis of variance was used to analyse the data.
RESULTS: The mean age of the group was 50.9 years: patients were on average obese, with a body mass index of 31.9. Two patients could not tolerate CPAP and one could not wear the MAS. The mean AHI decreased from 22.2 at baseline to 3.1 with CPAP and 8.0 with MAS ($P < 0.001$) and sleep quality also improved. Daytime sleepiness reduced from 13.4 to 8.1 with CPAP and 9.0 with MAS ($P < 0.001$). There were no differences between the two treatments. CPAP was successful in all subjects and the MAS in 70 per cent. Despite this, 17/24 subjects preferred the MAS.
CONCLUSIONS: (1) A MAS may be a suitable alternative to nasal CPAP in patients with mild or moderate OSA. (2) The MAS was well tolerated and preferred by the majority of subjects. (3) Larger studies with long-term follow-up are needed before a MAS can be offered as a definitive alternative to nasal CPAP in this patient group.

141 PULP REACTIONS TO EXPERIMENTAL TOOTH MOVEMENT

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AIM: To investigate the influence of sustained mechanical stimulation during orthodontic tooth movement on pulp tissue.

MATERIAL AND METHODS: Tooth movement was induced by inserting 0.15 mm elastics between maxillary M1 and M2 of 8-week-old male rats that were labelled with H^3-TdR and killed in groups, 6–7 animals each, together with equal-sized groups of labelled control animals at intervals between 1 and 168 hours. Autoradiographs of 2.5 μm thick mesiodistal sections, stained with haematoxylin and eosin or for non-specific esterase (NSE), were used to assess, in standardized measurement areas in the coronal, mid and apical three compartments of the pulp of M2, the following parameters: percentage of H^3-TdR-labelled fibroblasts, endothelial cells, and NSE-positive macrophages within the resident cell populations, aberrant changes in the odontoblast layer and blood vessels, signs of vacuolization, oedema, haemorrhage, reticular atrophy, irregular predentine formation, and internal dentine resorption. The severity of each pathological change was rated by a numerical score, which was used for quantitative analysis. Statistical significance was tested using ANOVA and Tukey's test.

RESULTS: Signs of pathological tissue changes appeared within 24 hours of mechanical stimulation and increased with time as shown by a significant ($P < 0.05$) increase of the corresponding scores in all compartments. A significant ($P < 0.001$) percentage increase in NSE-positive macrophages was found in the coronal compartment of mechanically stimulated tissue. The percentage of H^3-TdR-labelled fibroblasts increased significantly ($P < 0.05$) in the cell-rich zone of the mid and coronal compartments, in the pulp interior of the mid compartment and in the odontoblast layer and pulp interior of the apical compartment. The percentage of H^3-TdR-labelled endothelial cells increased ($P < 0.01$) in the pulp interior of the mid compartment of stimulated tissue.

CONCLUSION: Orthodontic tooth movement might cause sufficient trauma to pulp tissue to result in an extensive early wound healing pulpal response.

142 TGF-β EXPRESSION PATTERNS IN RATS WITH CLEFT PALATE INDUCED BY β-AMINOPROPRIONITRALE

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AIM: To find a correlation between cleft palate formed by β-aminoproprionitrale (BAPN) administration and TGF-β expression patterns.

MATERIAL: Four timed-pregnant Sprague–Dawley rats and rat foetuses.

METHODS: Four timed-pregnant Sprague–Dawley rats were divided into one control pregnant rat and three experimental pregnant rats. At gestation day 13, BAPN-monofumarate salts [(C3H6N2)2·C4H404, Sigma Co.] were individually, orally administered to three pregnant rats at a ratio of 1 g/kg body weight. Four pregnant rats were sacrificed on day 20 post coitus (pc), as palatal closure in rat finishes on day 17 pc. The total number of foetuses from the four pregnant rats was 45, and they were divided into two groups. Six cleft foetuses were delivered from the three BAPN-dosed pregnant rats, three of which were used for immnunohistostaining and three for western blot analysis. Three foetuses served as the control group.

RESULTS AND CONCLUSION: The TGF-β expression patterns in rat foetuses showed the following: (1) osteoblast and mesenchymal cells of cleft palate rats were of low expression compared with those of the control group; (2) the cleft palate rats did not show any difference in TGF-β expression of osteocytes from the control rats; (3) in western blot analysis, the thickness of the TGF-β band in the cleft palate rats was thinner and more diluted than that of the control rats.

143 FACTORS INFLUENCING THE SAGITTAL MANDIBULAR RANGE OF MOTION

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AIM: Evaluation of the mandibular range of motion in the sagittal direction/maximum protrusion and its correlation to different factors: age, gender, Angle-Class, orthodontic treatment, time of day, and training.

SUBJECTS AND METHODS: A plane metal plate was used as a border movement-recording device and fixed to the maxillary dentition before registering maximum protrusion. Parallel to the labial surfaces of the mandibular incisors, the border positions of the mandible were marked with a pencil on the plate. The marks on the plate, indicating the range of movement, were measured with a calliper. Maximum protrusion of the untreated subjects in three different age groups showing a Class I ($n = 80$) or Class II ($n = 74$) relationship were compared with the range in treated patients ($n = 4$l, formerly Class II relationship). The Angle Class before treatment was decisive for separation into different groups. Furthermore the change of border values was examined dependent on the time of day and training.

RESULTS: Maximum protrusion in the Class II relationship group (treated and untreated) was statistically significantly ($P = 0.01$) increased compared with Class I subjects. There were no statistically significant differences ($P = 0.29$) in sagittal mandibular movement ranges between patients treated from Class II to Class I with functional appliances and untreated subjects showing a Class II relationship. The investigation of dependency from time of day and training revealed further interesting findings.

144 A COMPARATIVE STUDY OF FOUR TOOTHBRUSHES IN PATIENTS WITH FIXED ORTHODONTIC APPLIANCES

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AIM: To evaluate the efficacy of two electric and two manual toothbrushes in 33 children undergoing fixed appliance orthodontic therapy.
MATERIAL: The brushes included were the Braun-Oral-B 3D plaque remover (electric), the Philips-Jordan HP 530 (electric), the Lactona orthodontic toothbrush (manual) and the Oral-B Advantage Control Grip (manual).
METHODS: Thirty-three patients tested each type of toothbrush in a randomly designed sequence. Plaque and gingival scores were recorded at baseline and after every four-week test period. All patients received professional prophylaxis after each clinical evaluation. Analysis of the data was performed with non-parametric Friedman and Wilcoxon's signed rank tests.
RESULTS: No significant difference was found between the four brushes for any of the parameters measured. Comparison of the plaque and gingival scores between the upper and lower arch for each of the four brushes indicated that plaque removal was more efficient in the lower than in the upper arch.
CONCLUSION: There was no difference in efficacy between the two manual and the two electric toothbrushes in children undergoing fixed orthodontic appliance therapy concerning gingival index, bleeding on probing index, and plaque index.

145 CRANIOFACIAL MORPHOLOGY AND SOFT TISSUE PROFILE OF FEMALES WITH UNILATERAL CLEFT LIP AND PALATE

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AIM: To compare the craniofacial morphology of female patients with complete unilateral cleft lip and palate (UCLP) treated according to the Hannover treatment protocol with a non-cleft control group from the same centre.
METHODS: Cephalometric analysis was carried out according to Ross (1997). A total of 13 female patients with non-syndromic UCLP and 20 female controls, approximately 10 years of age, were included. Furthermore, a soft tissue analysis was carried out by evaluating lateral photographs.
RESULTS: Differences between the samples were statistically evaluated by analysis of variance (ANOVA with *post hoc* Tukey's test). No significant differences were found for the following measurements: N–S–Ba, Ba–N–ANS, Ba–N–A, and SNA. Although a significant retrognathism of the mandible was noticeable ($P < 0.05$), no significant difference in the maxillo-mandibular relationship was found. The retrusion of the upper ($P < 0.01$) and lower ($P < 0.05$) incisors was remarkable. Comparison of cephalometric analysis and corresponding soft tissue measurements showed a correlation factor of 0.6 for angular measurements of skeletal maxillo-mandibular relationship and a correlation factor of 0.7 for the relationship of the midface to total face height.
CONCLUSION: UCLP patients treated according to the Hannover treatment protocol show good craniofacial morphology, but in order to evaluate the treatment outcome an additional soft tissue analysis is necessary.

146 REPLICATION OF MESENCHYMAL CELLS IN THE CONDYLES DURING MANDIBULAR FORWARD POSITIONING

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AIM: To quantitatively assess the amount of replicating mesenchymal cells in the condyle during normal mandibular growth and during mandibular advancement.
MATERIAL AND METHODS: One hundred and fifty female Sprague–Dawley rats, 35 days old, randomly divided into 10 control groups (5 rats each) and 10 experimental groups (10 rats each). In the experimental groups, a functional appliance was used to keep the mandible in a continuous forward position. The rats were sacrificed after 3, 7, 14, 21, 30, 33, 37, 44, 51, and 60 days. One hour before death all rats were injected with bromodeoxyuridine (BrdU) intravenously. Tissue sections of 7 μm were cut through the condyle in the sagittal plane and stained with anti-BrdU antibody to evaluate the number of replicating mesenchymal cells. Haematoxylin stain was applied to observe cellular response.
RESULTS: Forward positioning of the mandible produced an increase in the amount of proliferating mesenchymal cells in the condyle. In all experimental groups there was increased uptake of the BrdU-labelled cells compared with the control groups. Both control and experimental groups showed the highest number of replicating cells on day 3, followed by a decline until day 30.
CONCLUSION: Mandibular advancement causes earlier mesenchymal cell proliferation, which is followed by differentiation into osteoblasts. Mandibular advancement increases the number of proliferating mesenchymal cells in the condyle, which could directly impact on the number of bone making cells.

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147 EIGHT-YEAR FOLLOW-UP OF EARLY TREATMENT WITH REVERSE HEADGEAR—A PILOT STUDY

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AIM: To investigate treatment and long-term changes in patients who had received early treatment of skeletal Class III malocclusions.

SUBJECTS: Ten subjects with skeletal Class III due to a retrognathic maxilla who had undergone early treatment with reverse headgear. The group was obtained at random from a larger sample of consecutively treated patients.
METHODS: Cephalograms obtained at the start and end of treatment, and at an 8-year follow-up were analysed according to Pancherz (1982).
RESULTS: Seven subjects had a positive overjet (POJ) and three a negative overjet (NOJ), at the 8-year follow-up. The positive treatment changes of overjet (7.4 mm) and jaw relationship (3.4 mm) were the same in both groups. The pattern of the skeletal and dental treatment changes differed between the two groups. In the POJ-group the positive treatment changes of the maxilla were more pronounced, and in the NOJ-group the positive treatment changes of the mandible were more pronounced. Post-treatment changes: the overjet relapsed twice as much in the NOJ group (9.5 versus 4.6 mm). Skeletal and dental maxillary post-treatment changes (11.3/5.9 versus 6.3/3.3 mm) were markedly more favourable and mandibular post-treatment changes somewhat more favourable (17.1/–1.3 versus 18.5/0.7 mm) in the POJ-group than in the NOJ-group.
CONCLUSION: Overall, in the POJ-group, the maxillary treatment and post-treatment changes were more favourable. The 'negative' overjet at follow-up was a result of insufficient maxillary skeletal and dental changes rather than excessive mandibular growth.

148 THREE-YEAR FOLLOW-UP OF EARLY TREATMENT OF PSEUDO-CLASS III WITH A SIMPLE FIXED APPLIANCE

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AIM: To investigate treatment and follow-up changes in patients who had early treatment of pseudo-Class III malocclusions.
SUBJECTS: Ten subjects with pseudo-Class III malocclusions who had undergone early treatment with a 2×4 appliance. The group was obtained at random from a larger sample of consecutively treated patients.
METHODS: Cephalograms obtained at the start and end of treatment, and at a 3-year follow-up were analysed according to Pancherz (1982).
RESULTS: All patients had a positive overjet at the 3-year follow-up. During treatment the overjet increased (4.9 mm), which was mainly due to protrusion of the maxillary incisors (4.3 mm), and small retrusion of the mandibular incisors (–1.2 mm), which also compensated for the negative change of jaw base relationship (–1.5 mm). Post-treatment changes: there was a small increase in overjet (0.9 mm) despite a negative change of jaw base relationship (–3.6 mm) because of maxillary incisor protrusion (2.6 mm) and mandibular incisor retrusion (–1.9 mm).
CONCLUSION: Correction of pseudo-Class III is mainly due to protrusion of maxillary incisors. Long-term stability of the overjet is due to continuous dento-alveolar compensation masking the mandible out-growing the maxilla.

149 THE EFFECTS OF TWO DIFFERENT TREATMENT APPROACHES ON PSEUDO-CLASS III MALOCCLUSIONS

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AIMS: To evaluate the effects of two different treatment alternatives on the hard and soft tissue profile changes in the treatment of pseudo-Class III malocclusions in the mixed dentition.
SUBJECTS AND METHODS: Twenty-five patients with pseudo-Class III malocclusions. A Han appliance was used in 12 subjects (8 females, 4 males) with an average chronological age of 10 years 10 months (group H) and a chin-cup + anterior expansion appliance in 13 patients (8 females, 5 males) with an average chronological age of 10 years 11 months (group C). Lateral cephalometric films were obtained before and after correction of the anterior crossbite. Thirty-eight parameters were evaluated.
RESULTS: In group H, anterior movement of hard and soft tissue point A, upper incisors and increase of upper lip length were significant ($P < 0.01$). In group C, anterior movement of point A, upper incisors ($P < 0.01$) and posterior movement of point Pg, lower lip base, chin and increase of upper and lower lip length ($P < 0.05$) were significant. In group H, skeletal and dentoalveolar contributions to overjet correction were 1.33 mm (31.3 per cent) and 2.92 mm (68.7 per cent), respectively, whereas in group C skeletal and dentoalveolar contributions were 2.23 mm (48.7 per cent) and 2.35 mm (51.3 per cent), respectively. The change of point Pg was statistically significant between the groups ($P < 0.05$).
CONCLUSION: In both groups anterior movement of upper incisors was effective for anterior crossbite correction. However, skeletal contribution was different; in group H anterior movement of point A and in group C posterior movement of point Pg proved to be effective. In group H, anterior movement of upper lip and in group C posterior movement of lower lip base and chin were effective for the correction of the soft tissue profile.

150 COMPARISON OF A DOUBLE PLATE APPLIANCE AND FACEMASK IN CLASS III MALOCCLUSION TREATMENT

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AIM: To compare the effects of a double plate appliance (DPA) and facemask in the treatment of skeletal Class III malocclusions.
MATERIALS AND METHOD: Data based on the pre- and post-treatment lateral cephalograms of 28 subjects with skeletal and dental Class III malocclusions and anterior crossbite. In the first group (7 boys, 7 girls, mean age 10 years 3 months) a DPA with two Cass III elastics, which exerted a force of 350–400 g, was used full-time except for meals. In the second group (7 boys, 7 girls, mean age 10 years 5 months) a Delaire type facemask with a removable intra-oral appliance

(FM) was used with a total force of 600 g. The patients were instructed to wear the appliance for approximately 16 hours a day. The treatment groups were compared with an untreated control group (8 boys, 6 girls, mean age 9 years 8 months) with skeletal and dental Class III malocclusions. Twenty-one angular and 19 linear measurements were evaluated.
RESULTS: The increase in ANB angle and the decrease in maxillo-mandibular difference in the treated groups showed significant difference compared with the controls. The increases in ANB and SNA angles in the FM group were significantly greater in the DPA group. Significant increases were observed in lower face height and Me–ANS in the FM group and these increases were significantly different compared with the other groups. The increase in molar relationship and the decrease in overbite in the treatment groups were found to be significantly different compared with the control group. The overjet increased significantly in both treatment groups but that in the DPA group was significantly greater than in the FM group. Protrusion of the upper incisors and retrusion of the lower incisors in the DPA group showed significant differences compared with the other groups.
CONCLUSION: Stimulation of the maxilla was achieved by both appliances. FM was more effective on skeletal relationships while dental changes were more significant with the DPA.

151 CONTROL OF THE VERTICAL DIMENSION USING RICKETTS' TYPE CERVICAL HEADGEAR

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AIM: To evaluate control of the vertical dimension using Ricketts' type cervical headgear in two groups of growing patients with Class II division 1 malocclusions.
SUBJECTS AND METHODS: In one group (n = 12) the patients were treated with cervical headgear alone, whereas in the second group (n = 12) they were treated with cervical headgear and a lower utility arch combination. The treatment groups were compared with a matched untreated group (n = 12). The mean ages of the subjects at the beginning of treatment was: cervical headgear group 8.85 ± 1.19 years; cervical headgear + lower utility group 9.23 ± 0.76 and control group 8.62 ± 0.78 years. The average treatment time was 1.4 ± 0.6 years. The cervical headgear was used with an expanded inner bow and a 15–20 degree upward bend of the longer outer bow, 12–14 hours a day with a force of 450–500 g per side. The lower utility arch was used as described in the Bioprogressive technique. Linear and angular cephalometric measurements were made from the pre- and post-treatment records. Dental and skeletal treatment responses were compared using Wilcoxon and Mann–Whitney–U tests.
RESULTS AND CONCLUSION: Cervical headgear produced a Class II correction through maxillary orthopaedic and orthodontic changes. The increase in anterior face height was greater in the treatment groups than in the control. The treatment groups also exhibited a statistically significant increase in ramus height. Because of these effects, mandibular plane orientation remained relatively unchanged. There was absence of an opening rotation of mandible in both treatment groups. However, the lower utility arch did not appear to influence mandibular rotation response and produced lower incisor intrusion and distal tipping of the lower molar without extrusion. The treatment groups showed a significant reduction in maxillary protrusion and anterior descent of the palatal plane.

152 THE INCLINOMETER METHOD FOR RECORDING AND TRANSFER OF NATURAL HEAD POSITION CEPHALOGRAMS

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AIM: (1) To construct a device capable of recording and transferring the natural head position (NHP) established by self-balance and mirror position, (2) to assess its clinical use, and (3) to evaluate reproducibility of lateral cephalograms taken with this device.
MATERIAL: The device included two tilt sensors for the measurement of pitch and roll of the head. NHP of 20 dental students were established by self-balance and mirror position 10 times, recorded with the device and reproduced in the cephalostat via the device using an average of the measurements. Three lateral cephalograms were obtained in this position with a 30-minute interval between each. To assess reproducibility of the recorded position in the cephalostat using the inclinometer, the first two sets were obtained while wearing the device. During exposure of the third set of films, the device was not worn and this set was used for transfer of superimposed areas and determination of stability of the established position while the device was taken away from head.
RESULTS: The results revealed method errors of 0.6 degrees (SD: 0.9) between the first two sets of radiographs with a correlation coefficient of 0.985. Method errors between the first–third and second–third sets were 0.6 degrees (SD: 0.8) and 0.7 degrees (SD: 1), respectively, with correlation coefficients of 0.989 and 0.982.
CONCLUSION: The reproducibility of the method is high and the system is suitable for clinical use both for the recording and transfer of NHP in cephalometrics. This technique should make it possible to measure and reproduce head posture accurately. Minimizing and making the system radiolucent and integral with the radiographic equipment will make the device more versatile and decrease errors.

153 MAGNETIC RESONANCE IMAGING OF CR–CO POSITIONS IN NON-TEMPOROMANDIBULAR JOINT OVERJET SUBJECTS

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AIMS: (1) To compare subjects with a normal overjet with those with a large overjet and clinically healthy joints;

(2) to establish normative data concerning the difference between centric relation (CR) and habitual/centric occlusion (CO), and the radiographic appearance of condyles and deflective CR contacts; and (3) to compare condylar positions on magnetic resonance images (MRI) with articulator generated condylar positions.
SUBJECTS: Thirty non-temporomandibular dysfunction (TMD) subjects with intact dentitions and increased overjet (mean age: 20.7 years; mean overjet: 7.15 mm) and 30 control subjects (mean age: 21.9 years; mean overjet: 1.10 mm).
METHODS: CR–CO differences were determined on the MPI device of a SAM articulator. Condylar shape, erosions, and flattening were evaluated on dental panoramic radiographs. Deflective CR contacts were decided on mounted models. For subjects in the control group, subsequent MRI were taken with the mandible in CR and CO, and compared with the MPI findings of the same subjects.
RESULTS: There was a significant vertical difference between groups (0.93 mm versus control 0.63 mm; $P = 0.05$) but not sagittally and transversally. There were no differences in the number and location of CR contacts but significant differences between MRI and MPI data (sagittal plane $P = 0.000$; vertical plane $P = 0.007$) of the same individuals. The condyles were concentric in 73 and 87 per cent for right and left sides, respectively. Flattening was the most frequent radiographic finding in both groups (overjet 90 per cent; control 86 per cent); erosion was most often seen in females (72 per cent versus males 33 per cent; $P = 0.03$) in the overjet group. Thin condylar shape was more common in the overjet group (63 per cent versus control 36 per cent; $P = 0.03$).
CONCLUSION: Increased overjet patients show some significant differences compared with normal overjet subjects for the abovementioned features even in non-TMD individuals. Further research on TMD patients is needed to determine the role these features play in the aetiology of TMD.

154 DUTCH AND FINNISH CHILDREN: ARE THEIR FACES DIFFERENT?

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AIM: To determine differences between the longitudinal cephalometric studies of children from Groningen and Helsinki at three different age groups.
SUBJECTS: The Groningen Elementary School Study (GES) comprised 200 children born between 1945 and 1947, and the Helsinki Study (HS) 189 children born between 1967 and 1973. The final data for the GES were collected in 1975/76 (mean age 29.3 years) and for the HS in 1993/94 (mean age 23.4 years). From the GES 51 individuals, 26 boys and 25 girls, were chosen and from the HS 32 individuals, 16 boys and 16 girls, respectively. Each person had at least three cephalograms, one at each combination of the following age groups: 7/8/9, 15/16/17, and adulthood.
METHODS: Nineteen cephalometric variables were used to compare the studies. Both investigations included had cephalometric data of the foramen magnum.
RESULTS: Dutch males and females had a larger cranial base angle. They generally had a more retrognathic and divergent growth pattern with a steeper mandibular angle, a larger gonial angle and a shorter mandibular corpus compared with the Finns. The measurements in relation to the foramen magnum were not significantly different, with the exception of the angle between clivus and foramen magnum.
CONCLUSIONS: There was a remarkable difference in facial form between Dutch and Finnish males but less difference in females. It is therefore important for orthodontists to have access to cephalometric reference values for their own geographic populations.

155 CEPHALOMETRIC SUPERIMPOSITION OF RADIOGRAPHS WITH A TIME INTERVAL OF 2–4 YEARS

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AIM: To study whether the inclination of the SN line changes during growth, with the superimposition of two age-different cephalometric headfilms on the stable structures of the cranial base, and to investigate the extent of changes according to the period of observation.
SUBJECTS AND METHOD: Two groups of growing orthodontic patients. In group A the cephalographs were obtained with a time interval of up to two years (mean: 1.5 years; SD = 0.43). In group B the time interval was from 2 to 4 years (mean 2.8 years; SD = 0.73). The SN line was marked on the cephalograms. Two headfilms of the same patient were superimposed on stable structures of the cranial base, and the SN lines deviation was measured. The measurement, including the marking of SN line, was repeated after two weeks without knowledge of the first measurement, in order to check the measurement error. The result of the statistical assessment using the Student's *t*-test was negative. The measurement error was 0.3 degrees.
RESULTS: In group A, the mean SN line inclination was 0.44 degrees (SD = 0.57°). In group B, the SN line on the second cephalometric headfilms was posteriorly rotated by a mean of 1.58 degrees (SD = 0.94°). The difference between both groups was highly significant.
CONCLUSION: Pairs of cephalometric headfilms of individual growing patients obtained with an interval of two years can be superimposed on the SN line. The growth changes of this line over this period of time are close to the measurement error. Cephalometric headfilms of a growing patient with a time interval greater than two years must be superimposed on stable structures of the cranial base.

156 THE DYSFUNCTION INDEX: A HELPFUL INDICATOR TO PREVENT CRANIOMANDIBULAR AND CRANIOCERVICAL DYSFUNCTION

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AIM: To prove the effect of the Dysfunction Index as an indicator of craniomandibular dysfunction (CMD) and craniocervical dysfunction (CCD) in patients with orthodontic treatment need.
MATERIAL: Patient files, including clinical and manual findings and panoramic radiographs (n = 1098 females and n = 902 males). All patients had finished orthodontic treatment. Part of the examination had been to ask the patients about the occurrence of all types of headaches.
METHODS: Panoramic radiographs were traced to determine the Dysfunction Index. Variations of more than 6 per cent in condylar height between the left and right sides were taken as positive results and compared with sex, age, and malocclusion. Furthermore, the occurrence of headache was registered and compared with the data.
RESULTS: All subjects with a Class III malocclusion had a positive index ($P = 0.001$). Eighty per cent of all patients with deep bite or deep overbite had a positive index ($P = 0.027$). These morphological findings of a malocclusion seem to advance the development of CMD and CCD ($P < 0.01$). All patients aged 14 to 19 years with orthodontic treatment need suffered from headache (with a minimum occurrence of twice a week, rate 3 and more on VAS) ($P = 0.001$). Twenty per cent of the patients with orthodontic treatment need at 10–14 years of age also suffered from headache ($P = 0.012$).
CONCLUSION: The Dysfunction Index is a powerful indicator for detecting CCD and CMD. It is also suitable for functionally orientated prevention. It is recommended that in subjects with a positive index, a functional screening should be performed as part of the examination before orthodontic treatment is commenced.

157 IMPACTED LOWER PREMOLARS

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AIM: To determine the reason for changing the initial treatment plan in subjects with impaction of lower premolars.
SUBJECTS: Ninety-eight individuals (52 girls, 46 boys, average age 14 years) with impaction of a lower premolar.
METHODS: Accessory radiographic investigation with occlusal radiographs, and incidental computed tomographic scanning.
RESULTS: In 19 patients the initial treatment plan was changed after communication with the oral surgeon. The periapical and panoramic radiographs normally used by dentists and orthodontists often appear to be misinterpreted and this sometimes results in an unfavourable treatment plan. The reasons for the change in the initial treatment plan were (n = 20):

1. The impacted premolar remained in position — 10 per cent
2. Removal of the adjacent tooth instead of the impacted premolar — 15 per cent
3. Delayed spontaneous eruption — 20 per cent
4. Repositioning of the impacted premolar — 25 per cent
5. Delayed spontaneous eruption after space gaining — 30 per cent

CONCLUSION: Oral surgeons should have more active participation in determining a definitive treatment plan in subjects with impacted premolars to avoid unnecessary referral.

158 THE NEED FOR ORTHODONTIC TREATMENT AND THE AESTHETIC PREFERENCE OF DENTAL STUDENT PATIENTS

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AIM: To evaluate the attitude towards orthodontic treatment (including extractions) and patients' aesthetic expectations and to determine the perceptions of priority in orthodontic treatment.
MATERIALS: Twenty patients (dental students), 12 females, 8 males, 21–25 years of age, before, during, and after orthodontic treatment.
METHODS: Dental casts, initial and final lateral cephalometric radiographs, colour photographs and line drawings of facial profiles were analysed and evaluated. Patients' expectations, awareness of facial and dental aesthetics were assessed. The need for orthodontic treatment and the necessity of extractions and limitations of treatment were explained. The patients were divided into groups according to gender, age, severity of malocclusion, and necessity for orthodontic treatment. Questionnaires were distributed between patients and orthodontists.
RESULTS: There were noticeable differences between patients and orthodontists concerning the need for orthodontic treatment. The results demonstrated a correlation between gender and expectations of facial and dental aesthetics.
CONCLUSION: Orthodontists and dental students, as patients, share the same opinion regarding facial aesthetic preferences. However, there were significant differences in opinions concerning treatment need. Differences were found regarding treatment need in both genders, with female patients having higher expectations about the necessity for orthodontic treatment and facial aesthetics. Improved aesthetics were more important than a satisfactory occlusion for this group of dental student patients in spite of their knowledge of the limitations of orthodontic treatment for ideal aesthetic results.

159 IDENTIFICATION OF INTEGRIN SURFACE RECEPTOR PROTEINS ON HUMAN MASSETER MUSCLE CELL CULTURES

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AIM: Integrins are receptors for extracellular matrix (ECM) molecules that are expressed on the surface of muscle cells (myoblasts) and are thought to influence myogenesis and regeneration. Myogenesis can be recreated *in vitro* using primary cultures of human masseter myoblasts. These cells proliferate, migrate, fuse, and differentiate to form multinucleated myotubes (myofibres). Interactions with the ECM mediated via the integrins have a vital role during all of these processes. Although integrins have been identified in various non-craniofacial skeletal muscle systems, no attempt has been made to catalogue such expression in craniofacial skeletal muscle.
MATERIALS AND METHOD: Monoclonal antibodies specific to 11 α or β integrin subunits, on 17 cultures derived from masseter muscle and, for comparison, four cultures derived from soleus muscle *in vitro* were used. Flow cytometric techniques were used to identify expression of the integrin subunits.
RESULTS: Single cells derived from both craniofacial and somatic muscle expressed α1 [collagen (Col) receptor], α3 [fibronectin (Fn), laminin (Ln) and Col receptor], α4 (Fn receptor), α5 (Fn receptor), α6 (Ln receptor), αv [vitronectin (Vn) and Fn receptor], αvβ3 (Vn and Fn receptor), αvβ5 (Vn receptor) and β1 integrins on their surface. All of the ligands for these receptors are expressed in skeletal muscle. Neither α2 nor αvβ6 was identified. When cultures of varying cell densities were compared there were reciprocal relationships between α6/α5 and αxβ5/αvβ3 where levels of α6 and αvβ5 were higher in more confluent cultures, i.e. those cultures closer to terminal differentiation.
CONCLUSION: Cells derived from human craniofacial muscle express the same subset of integrins as those derived from somatic muscle. It appears that down-regulation of integrin subunits that bind fibronectin (α5 and αvβ3) are associated with myogenesis.

160 A SEMI-LONGITUDINAL STUDY OF ADENOID AND JAW GROWTH IN CHILDREN WITH NORMAL OCCLUSION

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AIM: To present a more objective standard of nasopharyngeal (NP) size and jaw dimension at each bone age, using the cervical vertebrae maturation index (CVMI), from normal occlusion children.
SUBJECTS: Normal occlusion children aged 6 to 17 years (62 males, 60 females) divided into five groups according to Hassel's CVMI.
METHODS: (1) Lateral cephalograms were taken annually for three years using a conventional method and subgrouped by bone age. (2) Image-Pro Plus was used for linear, area measurements. Images magnified ×4 were used to input the points. Linear measurements were read to 0.01 mm, and area measurements to 0.01 mm^2. (3) Digital callipers were used and linear measurements were read to 0.01 mm.
RESULTS: At the same bone age, the females' chronological age was approximately two years older than the males. There was a growth peak of NP height and depth between CVMI 1 to 2 in males, but in females NP height and depth gradually increased through CVMI 1 to 6. The nasopharyngeal airway increased most between the period CVMI 1 to 2 in both genders. Dentofacial measurements including intercanine width in both arches, maxillary intermolar width and palatal depth had high correlation coefficients with adenoid percentage.
CONCLUSION: Significant differences were found in NP dimensions and growth patterns between males and females. There was correlation among NP area and some jaw variables.

161 PHOTOELASTIC ANALYSIS OF STRESS DISTRIBUTION FOLLOWING CANINE RETRACTION WITH THE SEGMENTED TMA T-LOOP SPRING

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AIM: To visualize photoelastically the distribution of percentage force transmitted to the alveolus and surrounding structures using a new segmented TMA T-loop spring for canine retraction.
MATERIAL: Two-dimensional (2D) photoelastic model (PL-3) and resin tooth (maxillary canine, second premolars, first molar) were used.
METHODS: A prefabricated 0.017 × 0.025-inch TMA segmented T-loop spring (Ormco Corp.), used for reciprocal space closure and described by Burstone, was placed in three positions (0.25, 0.50, 0.75 B/L ratio) and was activated 5, 3, and l mm. Photoelastic analysis is a technique for the transformation of internal stress into visible light patterns. 2D photoelastic stress analysis was performed, and stress distribution was recorded photographically.
RESULTS: Stress patterns produced by 5, 3, and l mm of activation were controlled tipping and a bodily, root movement pattern in the canine and molar area.
CONCLUSION: The segmented TMA T-loop spring can produce the necessary force systems for controlled canine retraction.

162 CRANIOFACIAL MORPHOLOGY AND NASOPHARYNGEAL DIMENSIONS IN MOUTH BREATHING PATIENTS

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AIM: To statistically compare the antero-posterior and vertical dimensional variations of the nasal pharynx with craniofacial skeletal morphology in mouth breathing patients.
MATERIAL: Teleradiographs of 90 mouth breathing patients aged between 8 and 13 years of age: thirty were of patients presenting Class I, 30 Class II, and 30 Class III malocclusions. The assessment of the skeletal Class was made using the value of AO–BO measurement.
METHODS: For the analysis of films, angular and linear craniofacial and angular and linear nasopharyngeal measurements were used. Twenty quantitative variables (11 craniofacial and nine nasopharyngeal) and one qualitative variable (sex) were introduced. Analysis of the results was undertaken using a number of statistical tests.
RESULTS: The nasopharyngeal depth correlated with the antero-posterior disparity of the skeletal bases: it increased in skeletal Class II and decreased in skeletal Class III subjects, whether the disparity was represented by ANB angle or by AO–BO value. Nasopharyngeal height correlated with cranial base angle; when the relationship between the skeletal bases was Class II the nasopharyngeal height diminished; it increased when the skeletal bases were Class III. The nasopharyngeal height decreased with the increase in the value of the jaw angle. It varied with age: it increased progressively between 8 and 11, decreased between 11 and 12, and increased again between 12 and 13 years of age. Nasopharyngeal obstruction was more frequent in hyperdivergent patients. When the nasopharyngeal obstruction increased (S–PNS), the skeletal bases have a Class III relationship (AO–BO).
CONCLUSION: Thirty of 108 linear correlations were statistically significant with regard to the relationship between the craniofacial and antero-posterior and vertical nasopharyngeal dimensions which contributed to the craniofacial architecture.

163 EFFECTS OF CYCLOPHOSPHAMIDE ON FEMORAL EPIPHYSEAL GROWTH

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AIM: Cyclophosphamide (Cy) is a drug commonly used for treatment of neoplastic diseases and in preparation for bone marrow transplantation. The drug primarily affects dividing cells. Of particular interest to orthodontics is its effect on craniofacial growth of young children. Previous reports have indicated retarded closure of sutures and impaired bone growth. The purpose of the present study was to assess possible effects of Cy on cartilaginous growth and differentiation using the rat as the model animal.
MATERIALS AND METHODS: Three litters of young Sprague–Dawley rats were divided into control and experimental groups. The experimental group (n = 10) received two i.p. injections of Cy (30 mg/ml) with a three-day interval, starting from day 10. Control rats (n = 5) were similarly injected with sterile saline. Effects on the growing proximal femoral epiphysis were evaluated histomorphometrically as well as semi-quantitatively at 31 days old.
RESULTS: Compared with the controls, a significant reduction in the length of the femurs was found in the Cy treated group. This could be attributed to a significant reduction in the width of the growth plate (most significantly in the zone of hypertrophy). In addition, cell differentiation throughout the growth plates was clearly disturbed, involving nesting of cells, loss of polarity, and premature and impaired maturation as seen by areas of excessive hyalinization.
CONCLUSIONS: The effects of Cy on the growth plates in the experimental group were significant compared with the controls. However, the changes were not as extensive as previous reports have indicated. This could primarily be attributed to the lower and clinically more relevant dose of Cy used in the present study. The effects of Cy demonstrated probably also apply to other sites of cartilaginous growth, including the mandibular condyle. Treatment of children with Cy, therefore, may have a negative effect on growth of the mandible.