ABSTRACTS

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1 PREVALENCE OF MALOCCLUSION IN IRANIAN BOYS AGED 11–13 YEARS

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AIMS: To explore the possible significant age difference in permanent dentition status, occlusion, occlusal relationships, alignment, diastema and facial index, (n-gn)/(zy–zy) and provide information about occlusal variation among Iranian adolescent boys, and present an epidemiological panorama of their dental occlusions. The hypothesis was that occlusal variation is not independent of age and facial index (FI) (Proffit and Fields, 1993).

SUBJECTS AND METHODS: A random sample of 1063 male adolescents aged 11–13 years was studied. Angle's classification of malocclusion, permanent dentition status (caries, fillings, extractions and missing teeth), median diastemas, alignment, occlusal relationships (sagittal, vertical and transversal problems) and FI were recorded for each case. The data was handled statistically and chi-square and *P*-values were calculated.

RESULTS: The results indicated that age difference was significant for prevalence of median diastema and increased overjet among Class I malocclusion cases, caries and extractions (permanent dentition status), and anterior crossbite among Classes I, II and III.

CONCLUSIONS: (i) Prevalence of caries and extractions among Iranian adolescent boys was directly proportional to age. (ii) Prevalence of median diastema (positive bleaching test) was inversely proportional to age and became infrequent following eruption of the upper permanent canines. (iii) Increased overjet was significantly more common in younger boys and decreased proportionately with age. (iv) The relationship between FI and crowding for the whole sample was not statistically significant. (v) Occlusal variations differ numerically among different populations (El-Mangoury and Mostafa, 1990). This difference could be attributed to a number of factors. However, the occlusal variation follows a universal general distribution pattern for most world populations. Specifically, this pattern is arranged in the following descending order: Class I, Class II division 1, Class II division 2, Class III. The present study also confirmed this general pattern.

Proffit W R, Fields H W 1993 Contemporary orthodontics, 2nd edn, pp. 2–16, 149–184

El-Mangoury N H, Mostafa Y A 1990 Epidemiologic panorama of malocclusion. Angle Orthodontist 60: 207–214

2 A NEW FORCE SYSTEM AND A NEW APPROACH FOR REVERSE HEADGEAR DESIGN

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AIMS: A large number of Class III malocclusions are characterized by maxillary retrognathism. In the treatment of such problems reverse headgear is commonly used. In all the well-known reverse headgear designs, the unwanted side effect is the counterclockwise rotation of the maxilla during anterior movement. To eliminate this unwanted effect, a new reverse headgear was developed by changing the force and moment system and anchorage regions. The aim of this study was to investigate the orthodontic and orthopaedic effects of the newly developed reverse headgear.

SUBJECTS AND METHODS: This study was carried out on eight female and three male patients with Class III malocclusions due to maxillary retrognathism and high angles. The average age of the patients was 13.4 years. A full coverage acrylic cap splint-type RME appliance with special tubes was inserted and activated twice a day for 1 week to create sutural separation, following which the newly developed reverse headgear was worn. The reverse headgear has two parts: a facebow and a forehead pad. The facebow (1.55 mm diameter) is in an arch form and is inserted into the tubes on the acrylic splint. The extraoral part (3 mm diameter) is soldered to the intraoral one and extends parallel to the true horizontal plane and turns superiorly in front of the ear, ending in a hook at the parietal region at the level of the forehead pad. Heavy elastics were applied between forehead pad and facebow hooks. Because of the long lever arms, the moment acting upon the maxilla is increased to a greater extent, and at the same time the point of application is carried above the centre of the mass of the maxilla. Cephalometric radiographs were taken monthly.

RESULTS: Orthodontic: At the end of the third month, extrusion of the upper incisors and intrusion of the upper molars was observed. Orthopaedic: The maxilla was displaced anteriorly by a clockwise rotation.

CONCLUSIONS: This newly developed reverse headgear could be used effectively in the treatment of maxillary retrognathism cases with a high angle, vertical growth pattern and open bite tendency.

3 LIP BUMPER THERAPY IN MANDIBULAR ARCH PERIMETER DEFICIENCY CASES

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AIMS: To evaluate the effectiveness of a mandibular lip bumper with respect to reducing lower anterior crowding, maintaining and gaining space in the arch, permitting lateral dentoalveolar development, and moving the first molars distally.

SUBJECTS AND METHODS: The study was carried out on 11 patients (nine girls and two boys). The mean total age was 7.61 years (range 7.0–8.3). The mean treatment period with the lip bumper was one year. Prefabricated lip bumpers covered with acrylic shields, from canine to canine, were applied to all patients. Anterior pads were adjusted to remain 2 or 3 mm in front of the lower incisors at the level of the gingival third of the tooth. The lip bumper was reactivated every 6 weeks to maintain this position. Cast analysis:

Intermolar arch widths were measured on the pre- and post-treatment casts. The measurements were made from the mesio-buccal cusp tip and bucco-gingival margin of the molar. Arch perimeter was measured from the mesial sides of the lower permanent molars. Cephalometric analysis: Distalization and distal tipping of the mandibular molar and incisor proclination was measured on the lateral cephalograms.
RESULTS: There were significant increases in intermolar arch width and arch perimeter. Incisor crowding was decreased, the intramaxillary plane angle was increased and the first molar moved distally.
CONCLUSIONS: These results suggest that the lip bumper is an effective device to gain space and to expand the mandibular arch. It can be used, especially in the mixed dentition period, to correct dentoalveolar discrepancy.

4 A SIMPLE CASE COMPLEXITY INDEX

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AIMS: Case complexity, urgency and need (IOTN), are essential components of priority. This study tests the use of a complexity rating against actual patient management.
SUBJECTS AND METHODS: Since 1989, patients ready for treatment have been assigned a complexity and urgency rating in addition to IOTN. The complexity index was ranked in ascending order from A, least complex, to D, most complex, according to the anticipated resource implications. Resources may be affected by the hospital consultative input, the site of treatment, nature of appliances used, expertise of the operator, number of treatment episodes, time taken and multidisciplinary involvement. A sample of 180 chronologically discharged patients, whose management was considered complete, (excluding failed attenders, neonates and declined cases), was selected (45 from each band) and their records were examined retrospectively with respect to these resource factors.
RESULTS: Complexity A (simple) patients were all considered treatable within the general dental services (GDS) and received a mean of two outpatient consultative episodes (OCE). Of group B (minor complex), six were accepted for treatment within the hospital service using complex appliances. The mean treatment time (MTT) was 15.6 months (SD 17.1), with 14.6 (SD 16.1) as the mean number of treatment episodes (MNTE). None of complexity A or B patients required multidisciplinary input. Of the cases rated C (complex) an average of three OCE were required and 24 were treated in the hospital using complex appliances by orthodontically trained personnel. The MTT was 28.3 months (SD 38.8), with 16. 6 (SD 14.7) as the MNTE. Six patients required multidisciplinary involvement averaging 2.5 OCE. The complexity D (highly complex) patients were all offered treatment within the hospital service and all required complex appliances, of which 23 required appliances to be co-ordinated with another speciality. Forty-one cases required multidisciplinary input. The mean OCE was 6. The MTT was 31.3 months (SD 33.2), with 27.3 (SD 29.6) as the MNTE.
CONCLUSIONS: This complexity rating is a valuable measure of the resource implications of patient care and complements IOTN for priority assessment.

5 CEPHALOMETRIC APPRAISAL OF GLENOID FOSSA POSITION IN DIFFERENT FACIAL TYPES

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AIMS: To analyse the position of the glenoid fossa in subjects with different sagittal and vertical skeletal features in the mixed dentition.
SUBJECTS AND METHODS: The study was performed on a sample of 180 subjects (90 males, 90 females, aged 7–12 years), who were combined to form three groups (60 subjects each) according to sagittal relationships (skeletal Class I, Class II, Class III) and three groups (60 subjects each) according to vertical relationships (normal-, high-, low-angle). Computer-assisted cephalometric analysis comprised both sagittal and vertical measurements for the assessment of the position of the glenoid fossa (point Fs) in relation to surrounding skeletal structures. Point Fs (fossa summit) is the point where a line parallel to the stable basicranial line (SBL) lies tangentially to the superior curvature of glenoid fossa. The SBL is a line passing through point T (most superior point of the anterior wall of sella turcica) and tangential to the lamina cribrosa. The comparisons among the three groups according to sagittal relationships, and among the three groups according to vertical relationships were performed by Kruskal–Wallis test ($P < 0.05$) and by Mann–Whitney test with Bonferroni's correction ($P < 0.016$).
RESULTS: Glenoid fossa position was significantly more posterior in skeletal Class II when compared with skeletal Class III cases. In the vertical plane, glenoid fossa in relation to basicranial structures was significantly more caudal in low-angle subjects when compared with subjects with normal- or high-angle vertical relationships. Both basicranial structures and posterior nasal spine may be used for assessment of the vertical position of glenoid fossa.
CONCLUSIONS: As advocated by Droel and Isaacson (1972) glenoid fossa position represents an important skeletal factor in diagnosis and treatment planning of different skeletal disharmonies, both in the sagittal and vertical planes. The relationship between glenoid fossa and stable basicranial structures should be included in a comprehensive cephalometric assessment during the early developmental phases.

Droel R, Isaacson R J 1972 Some relationships between the glenoid fossa position and various skeletal discrepancies. American Journal of Orthodontics 61: 64–78

6 CONFOCAL LASER SCANNING MICROSCOPY (CLSM) OF TEETH IN CLEFT-LIP AND PALATE (CLP) PATIENTS

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AIMS: The quality of dental hard tissues in CLP patients was studied with non-destructive tomograms.

MATERIALS AND METHODS: Five teeth in the permanent and five teeth in the primary dentition were examined. Before recording the CLSM images the teeth were stored in a 1 per cent aqueous chloramine-B-hydrate-solution. The Leitz confocal laser scanning microscope used in this study is equipped with a variable energy (up to 40 mW) mixed gas Ar/Kr laser operated at 488 nm. The intensity of the reflected laser light is recorded in 256 grey steps. The experimental conditions (oil immersion objective ×40; numerical aperture 1.3; refractory index of the oil $n = 1.518$) allowed a maximum resolution of about 200 nm laterally, and about 300 nm axially. Thus non-destructive images of sound enamel can be obtained from subsurface regions to a depth of approximately 100 µm.

RESULTS: Differences of the surface and subsurface structure of the recorded teeth compared with normal samples could be shown. The physiological honeycomb morphology of the enamel structure was totally substituted by a chaotic appearance. Because there is no requirement to prepare samples, artefacts due to sectioning, drying, polishing, etc., could be excluded. Although interpretation of the CLSM images is still not fully developed, compared with a normal sample, worthwhile results could be obtained. The recorded teeth near the cleft showed a very different structural order. Clinically observed higher decay risk, acid conditioning, restoration possibilities, etc., have to be discussed based upon the CLSM data.

CONCLUSIONS: Clefting seems not to be restricted to well-defined areas of the alveolus and lip, but also involves hard tissue changes in the dentition. Decay predilection and enamel conditioning should be further examined.

7 PERIODONTAL LIGAMENT FIBROBLASTS HAVE *IN VITRO* BIOCHEMICAL PROPERTIES TYPICAL OF OSTEOBLASTIC CELLS

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AIMS: Identifying the biological properties of the cells residing within the periodontal ligament (PDL) will help in understanding the role that these cells play in the various functions of the periodontal ligament, and will improve the success of clinical procedures such as orthodontic tooth movement.

MATERIALS AND METHODS: Fibroblasts isolated from the human periodontium were cultured and characterized histochemically and biochemically with respect to their putative osteoblast-like properties.

RESULTS: Histochemically cultured PDL fibroblasts showed an intense staining for alkaline phosphatase. Biochemically, the basal alkaline phosphatase activity was high and increased 5-fold after stimulation with 1α,25-dihydroxyvitamin D_3. Moreover, immunofluorescence against osteocalcin (a highly reliable osteoblastic marker) was strongly positive. Von Kossa staining of the cell cultures revealed formation of mineral-like nodules.

CONCLUSIONS: These results indicate that human PDL fibroblasts exhibit *in vitro* phenotypic characteristics consistent with osteoblast-like cells, thus suggesting that such cells have the potential to differentiate into osteoblasts.

8 THE OVERLAP METHOD: ASSESSMENT OF CROWDING WITHOUT RECORDING ARCH PERIMETER

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AIMS: To devise and test a valid, computer-based technique to measure dental arch crowding, without the need to record arch perimeter either directly or by the application of a mathematical formula.

MATERIALS AND METHODS: Study casts of 66 children were used in this investigation. Thirty-six of these had clinically acceptable arch alignment; the remaining 30 exhibited varying degrees of crowding and irregularity. The technique was tested first on the 36 aligned lower arches and then on the upper and lower arches of the models with crowding. The models were placed, occlusal view uppermost, on the table of a reflex microscope interfaced to an IBM-compatible PC. Mesio-distal contact points of 11 teeth mesial to and including the first molars were recorded. A customized computer program calculated the mesio-distal overlaps between all adjacent tooth pairs. Because the dental arch is curved, the degree of overlap differs depending on whether this is calculated from left to right or vice versa: thus a mean was taken. A procedure for normalizing the positions of all rotated teeth was employed before the overlaps were calculated but repositioning bucco-lingually displaced teeth was found to be unnecessary. Results were compared with a 'clinical' assessment of the crowding, where irregularity was measured using a steel ruler.

RESULTS: For the aligned arches, 31 out of 36 computer calculations agreed to within 0.5 mm of the clinical assessment. All calculations agreed to the nearest millimetre. Where crowding was present, 52 out of 60 computed calculations were within 1 mm of the clinical measurements. This gave a correlation coefficient between the two methods of $r = 0.99$, thus validating the computer technique. When the system was used by different operators, inter-observer agreement was 0.93. The method error associated with the crowding measurement was 0.61 mm.

CONCLUSIONS: The overlap method allows the calculation of dental arch crowding without the need to record arch

perimeter, a calculation which has previously proved to be unreliable. The method is valid and reproducible and has the advantage that only the mesio-distal widths of the teeth need to be recorded. Since the program requires only the x-y co-ordinates of the tooth contact points for its calculations, it could be used with any model recording device.

9 SPONTANEOUS LOWER ARCH CHANGES WITH AND WITHOUT SECOND MOLAR EXTRACTIONS

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AIMS: To compare the spontaneous alterations in lower arch form and alignment subsequent to second molar extraction with the changes occurring when second molars remained *in situ*.

SUBJECTS AND METHODS: Forty-one children whose malocclusions met the following criteria were examined: treatment by distal movement of upper buccal segments only, followed by retraction and/or alignment of the anterior teeth, but no lower arch therapy. Upper second molars were extracted where clinically indicated. In 18 children, lower second molars were removed, whilst in 23 individuals these teeth remained *in situ*. Study casts were available at the start of treatment, at the completion of buccal segment retraction and at the end of fixed appliance therapy. Lower models were placed, occlusal view uppermost, on the recording table of a reflex microscope interfaced to an IBM-compatible PC. Using a custom-designed computer program, the following parameters were recorded: arch length and perimeter, intercanine and intermolar widths and crowding both of the entire arch and of the labial segment.

RESULTS: At the start of treatment, crowding was significantly greater in the second molar extraction group. During buccal segment retraction, increases in all lower arch dimensions and a reduction of crowding were seen in this sample. In the non-extraction group, the response was inconsistent. Arch length and perimeter reduced, whereas intermolar width tended to follow that of the upper arch. Crowding was unchanged. During the second stage of therapy, dimensions generally decreased in both groups. Over the two-year observation period, arch length and perimeter remained significantly greater and crowding significantly reduced in the lower second molar extraction group.

CONCLUSIONS: Extraction of lower second molars allows immediate small increases in lower arch dimensions with relief of crowding. This is not seen where second molars remain *in situ*. The trend is for these improvements to reduce but they are still present two years post-extraction. Whether they would continue to diminish is speculative and the behaviour of the groups once third molars have erupted is a matter for future investigation.

10 DISCOMFORT CAUSED BY ORTHODONTIC TREATMENT

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AIMS: The purpose of this study was to determine the perception of discomfort over time by patients undergoing orthodontic treatment.

SUBJECTS AND METHODS: Eighty-four individuals ($\bar{x}$ = 15.8 years) selected for comprehensive orthodontic therapy were included in the study. Fifty-one were treated with fixed appliances and 33 with removable appliances. The screening period started at the time of appliance insertion and ended with its removal. Each patient was given a questionnaire which included a verbal rating scale to evaluate the level, the area and the length of the pain experienced. The subjects returned the completed questionnaire each month during their appointment and received at the same time a new one.

RESULTS: From the total group, 66 per cent sensed pain at least once during their orthodontic treatment. Pain was documented by 21.2 per cent of those treated with removable appliances, whereas fixed appliances caused pain in 94 per cent. In this group, juveniles (≤18 years) reported 13.6 days ($= \bar{x}$) on which they sensed discomfort throughout the treatment period, whereas adults experienced pain for 25.5 days ($= \bar{x}$). The level of pain was highest during the initial treatment phase. In the case of discomfort after insertion of a new arch wire, the pain sensation reached its peak on the following day. Round wires in the early treatment stages caused on average more discomfort ($\bar{x}$ = 2.6 days) than rectangular wires in the late phases ($\bar{x}$ = 1.7 days). In general, the use of elastics during fixed appliance treatment increased the duration of pain. After insertion of separators on the posterior teeth, 82 per cent experienced some discomfort which lasted 2.2 days ($= \bar{x}$).

CONCLUSIONS: Treatment with removable appliances is generally associated with much less pain compared with treatment with fixed appliances. However, even patients undergoing fixed orthodontic appliance therapy are subjected to only moderate levels of pain. These results are useful in relating expectations of discomfort to subjects wishing to undergo orthodontic treatment.

11 MORPHOMETRIC ASSESSMENT OF ORTHODONTIC DEMINERALIZATION FROM PHOTOGRAPHS

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AIMS: To investigate a method of morphometric assessment of enamel demineralization surrounding orthodontic brackets.

MATERIALS AND METHODS: Twenty-two freshly extracted human teeth (11 molars and 11 premolars) were

used. One investigator coated the crowns of the teeth with an acid-resistant varnish, leaving a small window on the buccal surface. This was incrementally occluded by the varnish over a 10-day period, during which the teeth were placed in a demineralizing gel at pH 4.5. After varnish removal, a second investigator blindly quantitated the demineralized area by two methods, photographic and microscopic. Morphometric assessment was carried out using a 121 dot array (Weibel *et al.*, 1966). An array was placed within the microscope eyepiece, or a slide projected upon it. Each dot was recorded as positioned on the buccal surface of the tooth or not. The former were scored on a scale of 0 (no lesion) to 3 (obvious white spot). Assessments were repeated after one week. The readings were analysed using kappa statistics and Wilcoxon's signed-rank test.

RESULTS: The repeat readings from the photograph and microscope showed excellent agreement for reproducibility of grid positioning (unweighted kappa 0.90 and 0.97) and substantial agreement for diagnostic consistency (weighted kappa 0.76 and 0.69). Descriptive statistics showed that both techniques scored similar proportions of the buccal surface in the higher grades, 2 and 3 (mean 0.37 ± 0.08 and 0.34 ± 0.09).

CONCLUSIONS: Morphometric assessment is a reproducible technique, but the demineralization scale is subjectively based. Further investigation with confocal laser scanning microscopy, which displays variations in enamel mineral content, will provide a more objective assessment.

Weibel R, Kistler G S, Scherle W F 1966 Practical stereological methods for morphometric cytology. Journal of Cell Biology 30: 23–38

12 CEPHALOMETRIC CHARACTERISTICS IN COMPENSATED AND NON-COMPENSATED HIGH ANGLE CASES

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AIMS: To assess the dentoskeletal morphology in high angle cases with varying degrees of frontal dentoalveolar compensation.

MATERIALS AND METHODS: Lateral head films of 191 untreated and unselected high angle (ML/NSL > 40 degrees) subjects were analysed. The subjects were divided into two groups according to their dental age: late mixed dentition (group 1) and permanent dentition (group 2). Each group was divided into three subgroups with respect to the amount of overbite: A = overbite < 0 mm (insufficient compensation), B = overbite 0–4 mm (acceptable compensation), C = overbite > 4 mm (over-compensation).

RESULTS: Only 20 per cent of the high angle cases exhibited a negative overbite, indicating insufficient dentoalveolar compensation (subgroup A). In 50 per cent of the subjects an acceptable compensation (subgroup B), and in 30 per cent an over-compensation (subgroup C) was seen. In group 1 the high angle jaw base relationship was compensated by increased posterior rotation of the maxilla and extrusion of the upper and lower incisors. In group 2 the compensation was achieved by anterior rotation of the mandible and decreased eruption of the upper and lower molars.

CONCLUSIONS: In most high angle cases the divergent jaw base relationship is sufficiently compensated. The compensatory mechanism differs with dental age.

13 PROXIMAL BONE LEVEL AFTER TREATMENT WITH MAGNETS, SUPERELASTIC COILS AND STRAIGHT-WIRE APPLIANCES

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AIMS: To radiographically determine and compare proximal alveolar bone level changes in individuals who had completed rapid orthodontic treatment with magnets and superelastic coils followed by straight-wire appliances, and furthermore to relate the findings to individuals who had no history of orthodontic treatment.

MATERIALS AND METHODS: The proximal alveolar bone level changes were radiographically determined in 20 subjects (mean age 14.3 years, SD 2.00) a short time after rapid orthodontic treatment with magnets and superelastic nickel–titanium coils followed by straight-wire appliances. The findings were related to a matched control group of 20 individuals (mean age 14.3 years, SD 1.99) who had no history of orthodontic treatment. The proximal alveolar bone level change was determined on bitewing radiographs as the distance between the cemento-enamel junction (CEJ) and the alveolar bone crest (AC). The observation period, which included the treatment period, was 2.7 years (SD 0.65) for the treatment group and the corresponding period was 2.8 years (SD 0.65) for the control group.

RESULTS: A small but significant mean increase was found in CEJ–AC distance for both groups, amounting to 0.2 mm (SD 0.29) for the treatment and 0.1 mm (SD 0.22) for the control group. In the treatment group, the sites in the maxilla showed significantly greater CEJ–AC distances than in the mandible ($P < 0.001$), 0.3 mm (SD 0.33) versus 0.1 mm (SD 0.24). The mesial sites of the maxillary first molars in the treatment group showed the highest average increase in distance between CEJ and AC, mean 0.5 mm (SD 0.33). In neither of the groups were there any sites with bone loss, i.e. CEJ–AC distance exceeding 2 mm. No significant difference was found in CEJ-AC distance between teeth orthodontically moved with magnets and straight-wire appliances and teeth orthodontically moved with superelastic coils and straight-wire appliances.

The investigation was supported by grants from the Swedish Dental Society

14 MIGRATION OF PERIOSTEUM AND MUSCULAR INSERTION IN GROWING RAT MANDIBLES

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AIMS: To develop a method to estimate the migration of periosteum and muscular insertion in the mandibles of growing rats.

MATERIALS AND METHODS: Cylindrical metal markers (0.5 mm diameter) were manufactured from tantalum powder and gelatine. The markers were inserted at the right side using a needle to perforate the masseter muscle, ramus and medial pterygoid muscle. At the start, 14, and 28 days after insertion, axial and lateral cephalograms were taken to monitor the migration of the marker particles. The sites of the markers were observed histologically. Sham-operated rats (bone perforation only) and rats with no manipulation were used as controls to test the possible influence of the marker or of the procedure on mandibular growth. A series of studies was performed to standardize the mode and site of insertion, and minimize the bone damage due to needle perforation. The method was tested both in adult rats, where no changes in the position of the markers were expected, as well as in growing rats.

RESULTS: At the end of the experiment marker particles were surrounded by a thin fibrous layer, lymphocytes and macrophages. Preliminary results showed no significant differences in mandibular shape and size either between the rats with markers, the sham-operated ones and the controls, or between left and right sides of rats in each group. Caudal migration of the markers was observed in the growing rats while no significant movement of the markers occurred in the adults.

CONCLUSIONS: The insertion of tantalum markers was found to be a reliable method. It may be a useful instrument to elucidate how the migration of periosteum and of muscular insertions respond to induced changes of mandibular growth.

15 STANDARDIZED METRIC ANALYSIS OF MAGNETIC RESONANCE IMAGES OF HUMAN TEMPOROMANDIBULAR JOINTS

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AIMS: Magnetic resonance imaging (MRI) has become a useful tool for diagnosis of craniomandibular disorders. The main indication for MRI is a partial or total anterior disc displacement with or without reduction. Nevertheless there have been only a few attempts to establish reproducible criteria of diagnostic and therapeutic value. The aim of the present investigation was to develop a metric analysis for sagittal MRI to determine the disc position by objective and reproducible criteria.

MATERIALS AND METHODS: In analogy to lateral radiographic analysis, 23 measured points were defined for MRI in the closed mouth position, and eight points in the open mouth position. Based on these points, 42 linear and angular measurements were defined. The distance 'crest of fossa' to 'crest of eminence' was used as a linear reference for all measurements. All other distances were specified as relative dimensions. The mean disc position with the standard error of 36 joints of healthy individuals was determined in medial, central and lateral images as a reference for the review of 232 further joints with and without internal derangement. The results were compared with conventional visual estimation of the disc position.

RESULTS: After metric (visual) analysis, 29.7 per cent (17.7 per cent) of all joints showed a regular disc position, 26.3 per cent (22.0 per cent) a partial anterior disc displacement, and 36.2 per cent (53.8 per cent) a total anterior disc displacement.

CONCLUSIONS: The proposed MRI analysis allows a prediction of disc position, disc morphology, the slope of the eminence and the functional disc position, as well as the relative position of the condyles.

16 RELIABILITY OF MANUAL EXAMINATION TECHNIQUES FOR DIAGNOSIS OF DISC DISPLACEMENT

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AIMS: Clicking sounds are the most frequent symptom of craniomandibular disorders. However, there are different causes for TMJ clicking (disc displacement, deviation in form, subluxation of the condyle). Recently a manual technique for clinical diagnosis of different stages of disc displacement was described. The aim of the present investigation was to examine the validity of these techniques for diagnosing partial and total anterior disc displacement with reduction.

SUBJECTS AND METHODS: Forty-five female and 10 male patients (14–58 years of age) with unilateral or bilateral clicking were selected from the patient population at the Clinic of Orthodontics. After clinical examination by two examiners all clicking joints were diagnosed as 'anterior disc displacement with reduction'. With special manual examination techniques ('dynamic compression' and 'dynamic translation'), these were distinguished clinically between 'partial' and 'total disc displacement' and between 'stable' and 'unstable' reduction. Magnetic resonance images of these joints were also evaluated by two examiners without knowledge of the patients' data. At the end all data were correlated.

RESULTS: Eighty per cent of the partial and 94 per cent of the total disc displacements were correctly diagnosed. In addition the clinical findings of stable (74.7 per cent) and unstable reduction (100 per cent) were highly correlated with the MRI findings.

CONCLUSIONS: The present study shows that there is a high correlation between clinical findings with manual examination techniques and objective MRI findings.

17 SHEAR BOND STRENGTHS OF CERAMIC BRACKETS BONDED WITH LIGHT-CURED GLASS IONOMERS

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AIMS: The shear bond strengths of four light-cured glass ionomer cements used for direct bonding of ceramic brackets were evaluated and compared with a standard orthodontic composite resin in order to determine whether those cements can provide clinically acceptable shear strengths, without causing enamel damage.

MATERIALS AND METHODS: The following glass ionomer cements were tested: (A) Dyract Ortho (DeTrey/Dentsply), (B) Iocomp A20 (DMG), (C) Photac Bond (Espe), (D) Fuji Ortho LC (GC) and compared with Concise (Unitek/3M), a chemically-cured orthodontic adhesive, used as the control group (E). Two types of ceramic brackets (0.018-inch slot) for maxillary central incisors were evaluated: (i) Transcend 6000 (Unitek/3M), with a micromechanical retention in the bracket base and (ii) Fascination (Dentaurum), with a chemical retention. One hundred bovine mandibular incisors were embedded in acrylic with their labial surfaces exposed and ground wet for 5 minutes on 350-grit silicon carbide paper using a DPU4 machine (Struers). After cleaning with a mixture of water and fluoride-free polishing paste (Oral B), the enamel surfaces were rinsed with water to remove the polishing paste, dried with a stream of oil-free air and subsequently conditioned with 10 per cent polyacrylic acid (GC) for 10 seconds. The teeth were then rinsed with water for 30 seconds and dried. The manufacturers' guidelines for all the materials tested were strictly followed. After cleaning with prophylaxis paste, the teeth bonded with Concise were etched with 37 per cent phosphoric acid for 30 seconds. For polymerization each bracket was exposed to light of 450 nm wavelength and 280 ± 5 mW/cm^2 (Heliomat H2, Vivadent), with a 20 second burst to each of the mesial, distal, incisal and gingival margins. After bonding, the brackets were stored in tap water at room temperature for 24 hours and subsequently tested in a shear mode according to the ISO specification TC106/SC2/WG16. The bracket bases and the enamel surfaces were examined under a light stereomicroscope (×20) to determine the site of bond failure. The bond strengths were compared with a Student's *t*-test

RESULTS: See table below.

CONCLUSIONS: At least in the short term, all the bracket/adhesive combinations, except for A+2 and B+2, provide sufficiently high bond strengths to withstand the stresses of orthodontic therapy and allow safer debonding of ceramic brackets without enamel damage.

18 CEPHALOMETRIC EVALUATION OF PATIENTS WITH MICROCEPHALY

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AIMS: The aim of this cross-sectional investigation was a cephalometric description of patients with microcephaly to allow dento-maxillofacial identification of these subjects.

SUBJECTS AND METHODS: Ten patients (six males, four females) aged 7–12 years with microcephaly. The subjects underwent clinical examination then lateral and P-A cephlometric radiographs were taken. The tracings of the skull were digitized with a computer program (error limit 0.5 mm) and up to 26 variables for the lateral skull tracings and 10 for the frontal tracings were measured

RESULTS: The clinical examination demonstrated a craniofacial disproportion and a symmetrical reduction of craniofacial diameters, especially for the bifrontal diameter. Faces were characterized by large noses and auricles. Mental retardation and other anomalies were frequent. Oral examination demonstrated, in most patients, a Class II molar relationship. Analysis of the lateral skull radiographs showed a Skeletal II relationship, due to a mandibular deficiency. Lower facial height values were greater than norms. No facial asymmetry was recorded on frontal radiographs.

CONCLUSIONS: Subjects suffering from microcephaly show a dolichofacial pattern, a skeletal and dental Class II relationship and a dental biprotrusion. The deviations from normal are not too extensive and therefore early orthodontic treatment could be of advantage to improve facial aspects.

19 THE OUTCOME OF EXTRACTION TREATMENT IN CROWDING: ANALYSIS OF THE RESULTS IN THE PUBLIC HEALTH SYSTEM

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AIMS: To assess the standard and effectiveness of treatment provided in a hospital-based department of orthodontics where both postgraduate students and hospital trainees operate under supervision. The analysis was carried out to

	Bracket/adhesive combinations									
	A+1	B+1	C+1	D+1	E+1	A+2	B+2	C+2	D+2	
Shear strengths	7.17	5.23	13.86	18.50	14.88	4.56	3.21	16.27	13.48	29.7
SD (MPa)	3.80	1.40	5.44	6.76	9.90	1.51	0.75	2.55	2.05	5.94

evaluate the outcome of treatment in an attempt to improve the quality of the performance, focusing on internal audit.
MATERIALS AND METHODS: The records of 430 patients, who had consecutively completed treatment for crowding between 1984 and 1992 at the Department of Orthodontics, were examined. Criteria for inclusion in the study were: four premolars extracted, completed full fixed edgewise appliance treatment, availability of full records, no orthognathic surgery. Eight-eight patients met the requirements. The mean age at the start of treatment was 13.8 years and the sample included 63 females (71.6 per cent) and 25 males (28.4 per cent). Peer assessment rating (PAR) scores pre- and post-treatment were calculated, and the PAR change was used as an indicator of the improvement achieved. Assessment of the score was made by the same individual, calibrated in the use of the index. The error of the method was measured.
RESULTS AND CONCLUSIONS: The mean duration of treatment was 36.5 months, which would appear to be quite long. It could be explained, however, as only cases treated by students with no previous experience in orthodontics were included and also available resources were often limited, with delays in the supply of materials. The mean pre-treatment score was 31.7 (SD 10.0) and post-treatment 4.4 (SD 4.4). The mean percentage PAR score reduction, indicating the success of treatment, was 84.8. Only 2.3 per cent of the patients were categorized as 'worse or no different', 29.2 per cent 'improved' and 68.5 per cent of the cases 'greatly improved'. A good standard of outcome seems to have been achieved by the orthodontists in training in the sample examined, even though this was obtained over a longer period of time.

20 CHIN-CUP THERAPY IN SKELETAL CLASS III PATIENTS: A CEPHALOMETRIC EVALUATION

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AIMS: The purpose of this study was to evaluate cephalometrically the long-term influence of chin-cup therapy with a posterior bite-plane in skeletal Class III patients.
SUBJECTS AND METHODS: This study was performed on 17 skeletal Class III patients with a mean age of 8.7 years at the beginning of treatment. The subjects were treated with a chin-cup and posterior bite-plane in a maxillary Hawley appliance for a full-time wearing period of 35 months and then retained for 26 months by nightly wear. Thirty-seven angular and linear cephalometric measurements, including skeletal, dental and soft tissue parameters, were recorded, pre-treatment, end of active phase, and end of retention phase. The obtained data were then statistically tested with a paired *t*-test and Fisher's test.
RESULTS: The results indicated a significant increase in Saddle, Articular, SN–GoGn, *y*-axis, ANB and angle of convexity, and simultaneously a significant decrease in Go, Go1 and facial angle in the active phase of treatment. In the retention phase of treatment, a slight decrease in SN–GoGn, *y*-axis and ANB was evident, while facial angle was slightly increased.
CONCLUSIONS: The results were indicative of gross corrective changes in the craniofacial complex following the application of orthopaedic forces by the chin-cup, with more prominent effects in young patients, particularly in the early mixed dentition period. Although some relapse could be detected in the retention phase, the remaining effects were sufficient to produce an acceptable clinical response. Chin-cup therapy can, therefore, be considered as an effective therapeutic method for young skeletal Class III patients and as a preventive measure to avoid surgical correction.

21 CARIOSTATIC ABILITY OF RESIN-MODIFIED GLASS IONOMER CEMENTS FOR ORTHODONTIC BONDING

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AIMS: To compare the cariostatic ability of two resin-modified glass ionomer (compomer) cements, Vitremer (3M Unitek) and Dyract (Dentsply), with that of a conventional adhesive resin, Right-On (TP Orthodontics).
MATERIALS AND METHODS: One of the resin-modified cements was allocated to each of 26 patients (mean age 13.4 years) at random, in a half-mouth orthodontic bonding trial. Only non-carious premolar teeth scheduled for orthodontic extraction were included in the study. Each patient used a non-fluoride toothpaste for 4 weeks prior to bracket bonding and for the 4-week trial period. After extraction, the condition of the buccal enamel surface was recorded using a Nikon F3 camera, standard background lighting and Ektachrome colour transparency film. The colour transparencies of each extracted tooth (96 in total) were coded and randomly arranged and projected onto a screen in a darkened room. Each transparency was scored for decalcification by two examiners independently, under identical conditions, two weeks apart, using a modified caries index (0 = no white spot; 1 = frank white spot; 2 = cavitation). Kruskal–Wallis tests were carried out to determine whether there were any significant differences between the test and control materials.
RESULTS: Inter- and intra-examiner reliability were satisfactory (inter-examiner reliability = 83 per cent; intra-examiner reliability = 82 per cent). Two per cent of premolars bonded with the fluoride-releasing materials in contrast to 19 per cent of premolars bonded with the non-fluoride-releasing material developed decalcification after 4 weeks *in vivo*. A significant difference in decalcification was found between Vitremer and Right-On ($P = 0.033$), but the difference between Dyract and Right-On was insignificant ($P = 0.179$)
CONCLUSIONS: The cariostatic ability of Vitremer was superior to that of Right-On, but there was no significant difference in cariostatic ability between Dyract and Right-On.

22 ALLERGIC REACTION TO ORTHODONTIC ADHESIVES AND WIRES: A SURVEY

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AIMS: To identify and quantify: (i) orthodontic practice activities, adhesives and wire products used; (ii) the nature and frequency of allergic reactions on the hands and the oral mucosa; (iii) a possible relationship between adverse reactions, orthodontic materials and procedures among Turkish orthodontists, their patients and auxiliary personnel.
SUBJECTS AND METHODS: A questionnaire was distributed to 180 orthodontists who participated in the 4th International Congress of the Turkish Orthodontic Society held in 1994. One hundred and sixteen orthodontists responded (a response rate of 64.44 per cent). The questionnaire consisted of the following topics: (i) bonding materials and wires used over the past 3 years and the direct bonding method used by the orthodontist; (ii) weekly practice activity and glove use of orthodontists and auxiliary personnel; (iii) The occurrence of general allergies and any allergic reactions or lesions on the orthodontists, patients and auxiliary personnel. The data were divided into parameters and the responses of the parameters were coded and entered into a file for statistical analysis with the SPSS package. The Mantel–Haenszel X^2 procedure was used for statistical analysis.
RESULTS: The prevalence of intraoral and skin lesions on the hands over the preceding 3 years of exposure to adhesives was determined: orthodontists 4 4 per cent, auxiliary personnel 5 per cent and orthodontic patients 12.7 per cent. Express, Unite, Concise, System 1+ bonding agents and stainless steel, nitinol wires were used most often. No significant difference was found between the type of adhesive, the use of gloves, the health of hands and skin lesions on the hands. In contrast, there was a significant difference in the occurrence of intraoral lesions between the orthodontic patients who have a general allergy and those who do not.
CONCLUSIONS: General allergy cannot be a risk factor all the time for developing skin lesions on the hands and allergic response can be influenced by the individual variations.

23 COMPARISON OF DIFFERENT METHODS OF ESTABLISHING SAGITTAL APICAL BASE RELATIONSHIP

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AIMS: To determine a more reliable method of establishing sagittal apical base relationship by comparing different methods.
MATERIALS AND METHODS: The material consisted of lateral cephalometric radiographs taken before and after treatment of 14 girls (mean age 11.56 years) with skeletal Class II division 1 malocclusions. The monobloc and occipital headgear combination was used in the treatment for a mean period of 1.66 years. The following methods were examined: Angular–ANB, AXD; Linear–Wits A–D′, Wits measurements to Frankfort (AF–BF), Palatal (A_{pp}–B_{pp}) and Maxillary–Mandibular Bisector (AMM_{bis}–BMM_{bis}) planes. Descriptive statistics were calculated and covariance analysis was performed.
RESULTS: Before treatment the ANB angle showed high correlations (r = 0.7102–0.8545; 0.000 < P < 0.004) with the other six methods. The highest correlation was calculated between AXD and A–D′ (r = 0.9818; P = 0.000). The A_{pp}–B_{pp} method also showed higher correlation coefficients with AXD (r = 0.8370; P = 0.000) and A–D′ (r = 0.8580; P = 0.000) than that of the ANB (r = 0.7102; P = 0.004). No significant relationship was found between Wits and A–D′, AF–BF and AXD. The AF–BF was significantly correlated to AXD, A–D′, A_{pp}–B_{pp} and AMM_{bis}–BMM_{bis}; the correlation coefficients between AF–BF and the methods of A–D′ (r = 0.7690) and AXD (r = 0.7578) were found to be greater than the other two methods. AMM_{bis}–BMM_{bis} showed significant relatively low correlations with A_{pp}–B_{pp} (r = 0.6693; P = 0.009), A–D′ (r = 0.7278; P = 0.003) and AXD (r = 0.7635; P = 0.001). Evaluation of the treatment changes in sagittal jaw relationship showed no significant difference between methods (F = 0.93; P = 0.478).
CONCLUSIONS: High correlations found among ANB, AXD, A–D′ and A_{pp}–B_{pp} seem to show that they may be used interchangeably. It was concluded that none of these methods show any advantage over the others, while none of them was found sufficiently accurate to be used alone. Thus there is a need to search for alternatives to the conventional methods.

24 THE SHAPE OF THE MANDIBLE IN OPERATED CLEFT LIP AND PALATE (CLP) PATIENTS

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AIMS: To compare the shape of the mandible in a group of CLP patients with a control group in a cephalometric study.
SUBJECTS AND METHODS: The experimental group consisted of 19 subjects (8 females and 11 males) with unilateral or bilateral CLP. All operations had been carried out by the same surgeon according to the same protocol and technique. The patients were aged 18–35 years (mean 20.5) at the time of re-examination. The control group consisted of 20 subjects (10 females and 10 males) aged 20–30 years (mean 23.5). All patients in this group had a Class I occlusion with a full dentition. All the patients in the two groups were European and from the same area (eastern France). Cephalograms were obtained for all individuals under the same conditions. Nine mandibular variables were compared in the two groups with a Student's t-test for small samples.
RESULTS: In contrast to the control group, the following observations could be made in the CLP group: the dimensions of the mandible were all reduced (ArGo: P < 0.05; ArGn: P < 0.01; GoMe: P < 0.001); gonial angle was increased (ArGoMe: P < 0.05), thus maintaining an unchanged

anterior face height; point B was positioned more distally in the face (SNB: $P < 0.001$) but the dimensions of the chin did not differ to a significant extent. A step-by-step discriminant analysis using the intramandibular variables showed that 89 per cent of the controls and 80 per cent of the CLP patients could be correctly reclassified with the help of only two variables: body length (GoMe) and sagittal chin dimension (distance between point B and Pog projected on the mandibular plane).

CONCLUSIONS: In patients with CLP the shape of the mandible differs from norms. It is speculated that these peculiarities express a specific model of morphogenic influence resulting from functional adaptation to restricted maxilla and pharyngeal conditions.

25 RELIABILITY OF MEASUREMENTS MADE BY MEANS OF THE REFLEX MICROSCOPE

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AIMS: Although there is scientific evidence that the Reflex Microscope® (Reflex Measurement Ltd, Somerset, UK), is a very accurate instrument for measuring three-dimensional anatomical structures, some problems have been experienced with the measurement of tooth dimensions. The aim of this study was, therefore, to determine the repeatability of measurements on dental casts by means of the Reflex Microscope.

MATERIALS AND METHODS: Twenty sets of dental casts of children aged 10–15 years were randomly selected and measured by means of the Reflex Microscope. After one month the measurements were repeated by the same observer. Quantitative assessment of one set of dental casts involved 37 points on the upper and 27 points on the lower jaw. Definitions of the points recorded were taken from Moyers *et al.* (1976). The co-ordinates of the measured points were transmitted to a computer which calculated the 43 variables. These included mesiodistal and buccolingual dimensions of the anterior teeth and first molars, crown heights of the four lower incisors, length of the right and left first rugae, length and width of the papilla incisiva, and arch width.

RESULTS: There was no significant intra-observer difference between the means and variances of the assessed measurements. However the mean difference between the repeated measurements was significantly different from zero for three mesiodistal measurements of the anterior teeth and one buccolingual measurement of the upper right first molar. The differences between the two measurements ranged between 0.01 and 0.24 mm. The reliability according to the calculation with Dahlberg's formula was above 0.90 for all variables except for the mesiodistal measurement of the right central incisor (0.75) and for the measurements involving rugae and papilla incisiva (0.80–0.87).

CONCLUSIONS: Taking the reliability scores into account, it can be concluded that, on average, the Reflex Microscope is a reliable instrument for measuring anatomical dimensions on dental casts and that the main source of random errors is probably due to the difficulty in identifying certain landmarks, or their definitions not being sufficiently precise.

26 GENE EXPRESSION OF BONE SIALOPROTEIN AND COLLAGEN DURING TOOTH MOVEMENT

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AIMS: Movement of the teeth during orthodontic treatment induces bone remodelling, but the mechanism for this has not been fully elucidated. In this respect, the expression of mRNAs for bone sialoprotein (BSP), which is involved in biological mineralization, and type I collagen, which is the basic component of bone matrix, in periodontal tissue accompanied with tooth movement was investigated.

MATERIALS AND METHODS: The right side of the upper jaw of 7-week-old rats was used for experimental tooth movement according to Waldo's description. The animals were killed on the 1st, 3rd or 7th day. The left side was used for physiological tooth movement. The expression of mRNAs was examined by the *in situ* hybridization method. The area of interradicular septum (IRS) of the first molar was selected for light microscopic observation.

RESULTS: In the samples of physiological tooth movement, a high level of expression in both mRNAs was observed in osteoblasts along the mineralization front and in adjacent osteocytes or the IRS. In contrast, a low level of mRNA expression was observed in those cells on the opposite side of the IRS. In the specimens with experimental tooth movement, a high level of expression was detected in the tension side of osteoblasts along the IRS from the 1st day for type I collagen and from the 3rd day for BSP, but negligible reaction in the compression side of osteoblasts and osteocytes, which had shown intense physiological signalling.

CONCLUSIONS: Gene expression of BSP as well as that of type I collagen was related not only to mineralization in physiological bone remodelling but also to mineralization by activated osteoblasts induced by orthodontic force. In addition, response to the artificial force was observed in osteocytes of IRS. Thus, BSP mRNA could be a useful marker of bone remodelling during tooth movement.

27 AN INVESTIGATION INTO THE BEHAVIOUR OF ORTHODONTIC ELASTOMERIC MODULES

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AIMS: To determine the influence of friction of different elastomeric modules used to ligate an archwire in a bracket. Two other aspects of friction were investigated: the effect of miniaturization of the bracket and the effect of time immersion in a simulated oral environment. An assessment

was also made of the failure strengths of different modules in the new and immersed states.
MATERIALS AND METHODS: Orthodontic brackets were mounted in a standardized manner on stainless steel strips to eliminate the bracket prescription. Six cohorts of 10 specimens were assembled, five using standard sized brackets and one using miniaturized brackets. Five types of modules were used to ligate a length of 0.018 × 0.025 inch stainless steel wire in each bracket. An Instron universal testing machine was used to record static frictional forces at the time of ligation and at weekly intervals over a 4-week period during which time the specimens were immersed in a water bath at 37°C. Scanning electron microscopy (SEM) was used to compare the nature of ligation on standard and miniaturized brackets. Finally, the Instron machine was used to record failure load strengths of new modules and those used in the friction tests.
RESULTS: Significant differences ($P < 0.001$) were found with regard to friction between the five types of elastomeric modules tested. The clear round modules demonstrated the lowest frictional values. Significant differences ($P < 0.001$) were also found in frictional values between the standard sized and miniaturized brackets and differences in configuration seen in SEM may account for these. Time immersion in a simulated oral environment had a variable effect. With regard to failure strengths, a wide variation was seen among the modules, with the clear round modules having the lowest failure strength and all showing a reduction in failure loads following immersion.
CONCLUSIONS: A wide variation in frictional forces may be seen using different types of elastomeric module. Different modules also have variable failure load strengths, and there may be a relationship between friction and strength. Miniaturized brackets demonstrated higher frictional forces which may be due to differences in vertical load created by bracket configuration. Immersion in a simulated oral environment affected both friction and failure strength.

28 INCIDENCE OF CLEFT LIP AND PALATE IN FLANDERS (BELGIUM)

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AIMS: To determine the incidence of cleft lip and/or palate [CL(P)] in Flanders in 1993, including live births, stillbirths, and clefts with and without associated malformations, with the ultimate aim of improving treatment and establishing reliable recurrence risk rates for use in genetic counselling of CL(P) families.
MATERIALS AND METHODS: Birth data were collected from two different sources, so that mutual control of the data was possible. Only children weighing over 500 g at birth and after 22 completed weeks of gestation were considered. The first source was the Centre of Perinatal Epidemiology which depends on the clinical report from every gynaecologist and paediatrician in Flanders, including a specific questionnaire about CL(P). The second source was the voluntary reports of the plastic surgeons and otorhinolaryngologists who agreed to co-operate; they reported every CL(P) baby born in 1993 seen in their practice. Several factors of these CL(P) babies were examined, e.g. maternal age, domicile, parity, mode of fertilization, frequency of twinning and multiple births, duration of pregnancy, birth weight and stillbirth (autopsy and cause of death). These factors were compared with a control group of healthy babies in an effort to determine some possible aetiological and hereditary factors.
RESULTS: In Flanders 89 CL(P) babies were born and registered in 1993. The patients were categorized according to the principles of Fogh-Andersen (1942) and Kernahan and Stark (1958). There were 26 children with an isolated cleft lip, 30 with a cleft lip and palate, 25 with an isolated cleft palate and 8 children with a cleft palate associated with other malformations.
CONCLUSIONS: Of the total of 66 780 newborns in Flanders for the year 1993, 89 children were registered with a CL(P). The average incidence of CL(P) in Flanders is 1.33 per 1000 births.

29 MOLAR STABILITY USING DIFFERENT MODALITIES OF INTRAORAL ANCHORAGE

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AIMS: To evaluate maxillary first permanent molar stability in terms of mesial movement and rotation during canine retraction.
SUBJECTS AND METHODS: The study was conducted on a sample of 43 adults (20 males, 23 females) with an age range of 16–19 years. The sample was restricted to Angle Class I cases with varying degrees of crowding that required extraction of the first premolars and retraction of the canines. A sectional edgewise technique was utilized applying 0.018-inch stainless steel wire and a continuous elastic chain for canine retraction. The traction force was measured by a Correx gauge and was adjusted to 150 g/cm^2 for each segment. The sample was divided into four groups: (1) Nance holding arch group; (2) transpalatal bar group; (3) H-bar group; (4) control group. Assessment of mesial and rotational movements of maxillary first molars was carried out by means of pre- and post-treatment dental models. The models were photocopied using a Xerox machine at a magnification of 1:1. Linear and angular measurements were designed and used to assess mesial and rotational movements of the maxillary molars.
RESULTS: Based on statistical analysis, the following results were obtained: The Nance holding arch was the most efficient concerning resistance to mesial movement of the first permanent molar, and proved efficient in controlling rotational movement of the molar. The transpalatal bar was the most suitable as regards resistance against rotation of the molar.

However, it showed some resistance to mesial movement. The H-bar demonstrated a similar rotational control, while the resistance to mesial movement was confined.
CONCLUSIONS: As regards the control of the mesial movement of the anchored teeth, the Nance holding arch can be highly recommended. For greater rotational control, the transpalatal bar as well as the H-bar is primarily indicated.

30 TMA PALATAL ARCH AND QUADHELIX: A COMPARISON OF MECHANICAL PROPERTIES *IN VITRO*

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AIMS: To investigate the force in expansion and the moment in rotation and torque delivered by palatal arches made of TMA compared with a quadhelix, and to evaluate the influence of wire material, wire size, and presence or absence of loops.
MATERIALS AND METHODS: Five identical devices, built by the same orthodontist on a template, were tested for each of the following types of arch: (i) palatal arch, TMA 0.032-inch wire, without loops; (ii) palatal arch, stainless steel 0.032-inch wire, without loops; (iii) quadhelix, stainless steel 0.032-inch wire; (iv) quadhelix, stainless steel 0.036-inch wire. The arch shape was constant. Two different testing machines were used, one measuring forces and the other moments at different levels of activation (1–10 mm with a 1 mm interval in expansion, both in activation and deactivation; 2–10 degrees with a 2 degree interval in rotation and torque).
RESULTS: The TMA palatal arch showed the lowest force values (100 g at 10 mm activation) among the tested devices; the force delivered by the TMA palatal arch was 38 per cent of the force delivered by the stainless steel 0.032 arch, and 40 per cent compared with the stainless steel 0.036 quadhelix. Moment values in rotation and torque movements of the TMA palatal arch were also the lowest when compared with the other devices. The TMA palatal arch showed the lowest load deflection rate and the highest springback as a consequence of the mechanical properties of its wire material. Although the presence of loops and wire size had a great influence on force and moment values, the wire material played a major role in determining the mechanical properties of the tested devices.
CONCLUSIONS: It appears that the TMA palatal arch enhances the positive characteristics of the quadhelix appliance when tight and constant forces and moments are needed for tooth movement, showing a lower load deflection rate and higher springback, due to the mechanical properties of TMA. These characteristics can be of clinical relevance when considering the influence of force level on tooth movement, number of activations needed and chairtime, therefore suggesting the possibility of using the TMA palatal arch as an alternative to quadhelix.

31 BONE RESORBING FACTORS: EFFECT ON ORTHODONTICALLY INDUCED PERIODONAL REMODELLING

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AIMS: The effect of bone resorbing factors (*in vitro*) on (*in vivo*) orthodontically induced periodontium hard tissue remodelling was measured. The extent of bone and root resorption, specifically, was quantified in response to various bone resorbing factors.
MATERIALS AND METHODS: Seventy-five 7-week-old, male, Swiss–Webster mice, had orthodontic appliances placed between the mandibular incisors and left first molar. The mandibular right molar served as the control. The appliances remained active for 13 days. The mice were killed and the mandibular first molars with intact periodontium were removed and immediately placed in organ culture. The experimental organ culture systems had prostaglandin E_2 at 0.10 μg/ml, 0.01 μg/ml; vitamin D_3 at 10^{-6} M, 10^{-8} M, 10^{-10} M, 10^{-12} M; interleukin β1 at 10 ng/ml, 1.0 ng/ml or 0.1 ng/ml added to the organ culture medium at time = 0. The organ culture was terminated after 12 or 24 hours of incubation. The periodontium explants were immediately placed in fixative, decalcified, embedded in paraffin and prepared for histological staining The sections were stained for tartrate-resistant acid phosphtase and the sections evaluated for root and bone resorptive activity. A MOP-videoplan morphometric program was used to count the number of bone and root resorptive lacunae, and to measure the area of the bone and root resorptive area, as well as the area of bone and root surface for each molar explant.
CONCLUSIONS: The hard tissue resorptive process orthodontically initiated *in vivo* continued *in vitro*. The bone resorbing factors incorporated into the organ culture medium increased the extent of the hard tissue resorptive activity measured *in vitro*, in all experimental explants. This observation was statistically significant in the 0.1 ng/ml of interleukin β1 and 10^{-12} M vitamin D_3 experimental groups. The numbers of resorptive lacunae were not increased. However, the area of the resorptive lacunae was affected in the experimental organ culture systems. Studies are in progress to evaluate further the effect of other bone resorbing factors on orthodontically induced hard tissue remodelling.

32 ORTHODONTIC FORCES ON OSSEOINTEGRATED IMPLANTS IN THE RABBIT: HISTOLOGICAL ANALYSIS OF A PILOT STUDY

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AIMS: Osseointegrated implants seem to be able to provide a

valid anchorage to counteract orthodontic forces, even though the phenomena occurring around the bone tissue surrounding the implant would not appear, as yet, to have been clearly analysed and described. The present research aims to evaluate the possible tissue response after application of orthodontic forces on osseointegrated implants.
MATERIALS AND METHODS: Sixteen titanium screw implants were positioned on the calvarium of seven rabbits (five had two implants, two had three, and one animal was used as a control). Four months after the surgical procedure, after reaching osseointegration, the implants were distalized with NiTi coil springs, applying a 100 g constant force. Four weeks later, on the basis of the bone turnover of the rabbit and of previous experiences described in the literature, each animal was administered 90 mg of tetracycline to mark any possible bone remodelling occurring around the implants, under fluorescent microscopy. The animals were killed after 7 days, and implants and bone tissue were removed in 'block sections' for histological tests.
RESULTS AND CONCLUSIONS: Continuity between titanium and bone was observed in all cases, confirming the osseointegration. Around the control implants large medullary spaces were observed in the bone, with the same characteristics present on the tension side of the implants which underwent the application of force. The bone structure was similar to the normal bone in the calvarium of the rabbit. On the compression side, bone lamella, mainly parallel to the implant surface, and small bone trabeculae in formation, were observed. The tension zones between implants were consistently rich in medullary cavities extending to the implants themselves. There would seem to be an obviously different response in the various areas examined, with remarkable 'normalization' of the bone over a short period of time. Even though bone turnover in the rabbit is faster than in humans, it could be suggested that the early application of certain loads or forces could accelerate the normal maturation process of peri-implant bone tissue in clinical practice. The suggested hypothesis is at present being further tested on a larger sample.

33 ASSESSMENT OF CERVICAL VERTEBRAL DIMENSIONS IN SKELETAL MATURATION

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AIMS: To evaluate cervical vertebral dimensional changes due to growth, and to determine whether these changes could be used as a predictor of skeletal maturation.
MATERIALS AND METHODS: Cross-sectional data included lateral cephalometric radiographs taken before orthodontic treatment of 325 patients with different malocclusions (182 girls, 143 boys) aged 9–15 years. Care was taken in the skeletal and chronological age selection of the subjects. Twenty-three reference points were recorded on the lateral cephalometric radiographs related to the first, second, third and fourth cervical vertebrae, and 13 measurements were performed. Nine ratios were calculated to evaluate the relationship between chronological age and the change in the sizes of the cervical vertebrae. ANOVA was performed to determine the differences between the chronological age groups. When a significant difference was found, Duncan's multiple range test was used to determine the statistical difference. The level of significance for all tests was 0.05.
RESULTS: Significant differences were found between the chronological age and the first, second, third, fifth, eighth and ninth mean ratios. The first, second, third and ninth mean ratios differed significantly in some of the age groups, while the fifth and the eighth mean ratios varied significantly with most age groups. Mean ratio of the anterior body height to lower body width increased significantly due to the acceleration of growth and the increase in age, with values of 0.53–0.91 and 0.51–0.86 respectively for the third and fourth cervical vertebrae.
CONCLUSIONS: Ratios of the cervical vertebral dimensions are proportional to the increase in age and acceleration of growth. Ratios of the anterior body height to lower body width of the third and the fourth cervical vertebrae could be used to predict and determine skeletal age.

34 BENDING AND TORQUING ACCURACY OF THE BENDING ART SYSTEM (BAS)—PRELIMINARY RESULTS

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AIMS: The BAS is a system for the fully automated manufacture of individual archwires when applying the multiband technique. The archwire is formed by stringing together several individual bends and torsions. This study aimed to establish the reproducibility of these individual bends and torsions using 0.016 × 0.016 inch steel wire.
MATERIALS AND METHODS: The first series of tests included 10 bends of varying strength (setting range 6–24 degrees); the second series of tests included five bends of varying strength (setting range 2–37 degrees). Each test was repeated 10 times. Using a measuring microscope, the bending and torsion values of the worked pieces of wire were established and evaluated statistically.
RESULTS: There was a standard deviation for the entire setting range of $x = 0.313$ degrees and a coefficient of variation of $x = 0.014$ and a relative coefficient of variation of $x = 0.45$ per cent. Similarly, there was a standard deviation for the torsion of $x = 1.199$ degrees, a coefficient of variation of $x = 0.108$ and a relative coefficient of variation of $x = 3.414$ per cent.
CONCLUSIONS: The present study is not able to establish to which degree the errors determined are attributable to inhomogeneities of the wire used, to the measuring technique or to the BAS. It was ascertained, however, that the accuracy of the BAS, when used for individual bending and torsion procedures, was of a clinically acceptable magnitude. Further tests are required for a final judgement on the bending accuracy of BAS.

35 POSTPUBERTAL FACIAL GROWTH IN CLASS III SUBJECTS

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AIMS: To determine the magnitude and the direction of postpubertal mandibular and maxillary facial growth in Class III males and females.

SUBJECTS AND METHODS: The sample consisted of 25 untreated subjects (14 females, 11 males) who had Class III skeletal and dental characteristics and whose lateral cephalograms were taken at 14, 16 and 20 years of age. The sample was derived from the longitudinal sample of the Burlington Growth Centre and the Bolton–Brush Growth Center in Toronto, Ontario, and Cleveland, Ohio, respectively. Means and standard deviations were calculated for the selected cephalometric variables. Correlation coefficients and *t*-tests were used to investigate the relationship between the selected pairs of measurements.

RESULTS: Overall mandibular growth as measured from Co–Gn was approximately three times that of the overall maxillary growth as measured from Co–A. Correlation analysis revealed a statistically significant relationship between the estimates of mandibular growth from either articulare or condylion. Mandibular growth was almost twice as large for the age period 14–16 years as for the age period 16–20 years. The increase in posterior face height was slightly more than the increase in anterior vertical face height. The mandibular plane angle decreased 0.84 degrees during the age period of 14–20 years, suggesting a closing rotation of the mandible. The mandibular incisors appeared to tip labially with advancing age.

CONCLUSIONS: The potential for significant postpubertal growth in Class III subjects has been shown. However, the variability in growth of the sample limits the ability to predict postpubertal growth for an individual patient.

36 CEPHALOMETRIC FLOATING NORMS FOR THE MIXED DENTITION

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AIMS: To calculate cephalometric floating norms as a means to assess individual craniofacial patterns in the mixed dentition as a diagnostic tool in interceptive orthodontics.

SUBJECTS AND METHODS: A sample of 200 untreated subjects (87 males, 113 females) with ideal occlusion in the mixed dentition (age 10.71 ± 2.15 years, range 7–14) was analysed. Criteria for case selection comprised absence of caries, congenitally missing or supernumerary teeth, malformative syndromes, and presence of normal occlusal relationships. The following measurements were performed on lateral cephalograms: S–N–A, S–N–B, NL–NSL, ML–NSL, N–S–Ba. Statistical analysis of the recorded data consisted of calculation of Pearson's correlation coefficients, linear regression analysis and multiple regression analysis.

RESULTS: All correlation coefficients among the cephalometric variables were significant ($P < 0.01$ to $P < 0.001$). According to the procedure described by Segner (1989), a correlation box was constructed on the basis of the equations resulting from regression analysis. Any horizontal line connecting the values of the cephalometric variables inside the box (harmony line) represents an harmonious craniofacial pattern in the mixed dentition. The range of accepted variability around this harmony line consists of the standard error of the estimate of the multiple regression analysis. Clinical cases will be shown to demonstrate the effectiveness of floating norms for the diagnosis of individual sagittal and/or vertical problems.

CONCLUSIONS: Conventional cephalometric analyses based on separate measurements are not able to provide adequate information about individual craniofacial patterns, since topographical correlations among cephalometric variables are not considered. Floating norms were proposed to overcome these limitations. Cephalometric floating norms for the mixed dentition can be used for: (i) treatment planning during this developmental phase, and (ii) the evaluation of the results of early functional/orthopaedic treatment starting from the deciduous dentition.

Segner D 1989 Floating norms as a means to describe individual skeletal patterns. European Journal of Orthodontics 11: 214–220

37 ULTRASOUND INVESTIGATIONS OF SUCKING PATTERNS IN HUMAN NEWBORNS WITH CLEFTS

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AIMS: Although early orthodontic treatment is recommended by cleft rehabilitation centres, opinions about the so-called 'drinking appliance' vary and its usefulness in a modern surgical therapeutic concept has been discussed. The aim of the present investigation was to analyse differences of tongue movement during bottle feeding between cleft and non-cleft babies. The effect of the incorporated 'drinking appliance' on the sucking ability and tongue pattern of cleft newborns was the centre of interest.

SUBJECTS AND METHODS: In a clinical study of 10 unilateral cleft and healthy babies with physiological development, ultrasonographical investigations of sucking patterns were undertaken. Ultrasound was applied in sagittal and transverse directions from submental, during bottle feeding, finger stimulation and rest periods. Cleft babies were examined with and without a 'drinking appliance' with corresponding bottle feeding systems during each meeting. One B-Mode and two M-Mode images were measured simultaneously and for precise research recorded on video. An ultrasound diagnosis gauge SSH-140 A (Toshiba), a PSF-37FT 3.75 MHz probe (Toshiba) and a S-VHS video cassette recorder AG-7330 (Panasonic) were used. Each subject was examined approximately every 4 weeks, a period

which requires the incorporation of new appliances to the cleft babies.
RESULTS: Ultrasound imaging of tongue movement provides excellent information about oral anatomical and functional conditions. The B- and M-Mode images in sagittal and transverse directions show the different muscle actions of the tongue during sucking, finger stimulation and rest periods.
CONCLUSIONS: Not considering the possibility of guiding the separated plates while using the growth capacity, the 'drinking appliance' is the key to harmony of functional tongue co-ordination. With the incorporated appliance, physiological tongue patterns could be found; without the appliance, irregular and unrhythmical sucking movements and tongue placement into the cleft were recorded.

38 THE EFFECT OF SURGERY ON THE FACIAL MORPHOLOGY OF PATIENTS WITH HEMIFACIAL MICROSOMIA

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AIMS: To investigate the changes, with treatment, in the faces of patients with craniofacial microsomia. The results of these procedures have been difficult to monitor because of the limitation of the methods that are available for measurement in three dimensions.
SUBJECTS AND METHODS: Sixty-five patients with hemifacial microsomia and 130 control patients were monitored using a three-dimensional optical surface scanner. They were divided by sex and age into four groups: 4–8, 9–12, 13–16 and 17+. Each of the craniofacial patients were mirror-imaged so that they were all left-sided anomalies. Both the craniofacial and control groups were then averaged to give an average facial morphology for each particular group. The differences between the craniofacial group and the control group were demonstrated using a registration programme which superimposes the two average scans over one another, and shows the difference between each of the facets using a colour code.
RESULTS: Although the patients were diverse, the results showed that in the female group 4–8 years, the faces were on average 7–9 mm smaller in the cheek and chin regions on the affected side in comparison with the control group of the same age. Despite the use of costochondral grafts, the female face at 9–12 years was still 5–7 mm smaller in the cheek and chin regions. At the ages of 13–16 years the deficiency in the cheek and chin regions was still 5–7 mm when compared with the control group. In the male group age 4–8 years, there was a deficiency of 7–9 mm on the left side. At the age of 9–12 the deficiency in the male group was similar to that of the female group of the same age. In the 13–16 age group the males showed a deficiency of 9+ mm in the lower jaw and left side of the face.
CONCLUSIONS: The deficiency of the soft tissues in these patients was more severe in males than females especially after puberty, and both groups were deficient when compared with the controls even after treatment.

39 INFLUENCE OF TREATMENT TIME UPON ORTHOPAEDIC EFFECTS

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AIMS: To examine whether orthopaedic effects differ according to the patient's dental stage.
SUBJECTS AND METHODS: The subjects consisted of 63 patients with reversed occlusion. Twenty-nine were in the deciduous dentition (group D) and 34 in the mixed dentition (group M). Both groups were treated with a specially designed orthopaedic facemask type appliance (MPBA). The effects of the appliance were investigated on 126 cephalograms before and after treatment. Angular measurements were performed on all cephalograms. Student's *t*-test was employed for statistical analysis.
RESULTS: The skeletal changes of group D were significantly larger than group M. There was no difference between groups D and M with regard to denture change. In group D the reversed occlusion improved faster than in group M. The mean period of treatment was 5.1 months in group D and 10.2 months in group M.
CONCLUSIONS: The orthopaedic effects were greatest when treatment was carried out in the deciduous dentition, confirming the validity of early treatment.

40 CORRELATION BETWEEN SKULL MORPHOLOGY AND INTEROCCLUSAL DISTANCE IN PATIENTS WITH A DEEP BITE

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AIMS: To evaluate any interdependence between skull morphology and functional parameters such as freeway space and speech clearance.
SUBJECTS AND METHOD: A total of 31 adult patients (25.5 ± 2.7 years) with deep bite (5.7 ± 1.5 mm, range 4–11 mm) were included in the study. Speech clearance was registered in all volunteers for several sound groups on a manual and on an axiographic basis. To determine freeway space, lateral radiographs were taken in habitual intercuspation and physiological rest position.
RESULTS: Speech clearance, obtained by manual measuring, varied from 3 to 7 mm and significantly exceeded axiographic values by 25–50 per cent. Further significant differences were demonstrable between the individual exercises, with axiographic measurements showing a distinctly closer correlation with freeway space as against manual measuring. Lateral radiographs showed that speech clearance increases with increasing interincisal angle; in this context the inclination of the upper incisors appeared to be of particular importance. Vertical skeletal parameters such as the facial

height index or the mandibular base angle did not correlate with speech clearance. The lateral radiographs showed a pronounced rotation of the lower jaw from intercusping to the rest position in patients with a steep position of the upper incisors, while translation at the anterior-caudal direction was observed in patients with a pronounced sagittal stop. No significant correlation between skeletal parameters and freeway space could be demonstrated.
CONCLUSIONS: The values obtained for the interocclusal distance, while speaking, depend on the measuring technique, on the sound groups pronounced, and on the inclination of the anterior teeth. Precision of the results obtained from axiographic methods is superior to that of manual determination. Axiographic evaluation is particularly valuable in patients with deep bites. The closest correlation between speech clearance and freeway space was found when 'OHIO' was pronounced. The height of speech clearance increases with an enlarged interincisal angle. An increase in interinsical angle is associated with a rotational movement of the lower jaw between habitual intercuspation and rest position.

41 A REGIONAL CLEFT CENTRE STUDY ON CRANIOFACIAL FORM

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AIMS: To evaluate the cephalometric characteristics of asyndromic white Caucasian patients with a range of cleft palate deformities.
SUBJECTS AND METHODS: In 40 patients aged 8–12 years (mean 10.2) with bilateral, unilateral and isolated cleft of the hard and/or soft palate (16 unilateral, 10 bilateral and 14 isolated clefts) lateral cephalograms were taken as part of a comprehensive ongoing study. All patients had received some form of presurgical orthopaedics in infancy and all primary repairs were carried out by one surgeon, with minimal surgery to the hard palate, but radical functional repair of the soft palate. Fifty hard and soft tissue cephalometric landmarks were recorded by computer digitization, with the cephalograms orientated at 7 degrees to the Sella–Nasion plane and the tolerance for digitization set at 0.2 mm. The data were stored as a series of angular and linear measure- ments and analysed with the SPSS statistical program.
RESULTS: For the purposes of comparison with accepted clinical norms, the salient skeletal cephalometric features are presented in the table below as mean values, along with their standard deviations.
The results showed evidence of bimaxillary retrusion in both the unilateral and isolated cleft, and mandibular retrusion in the bilateral cleft. However, the mean ANB difference for this age group appears favourable in comparison with other studies, and if sustained throughout later growth should reduce the need for further surgical intervention. There is an apparent reduction in the total anterior face height that is more obvious in upper facial height than lower. This suggests a reduction in vertical growth of the maxilla.
CONCLUSIONS: At this stage, the cephalometric results following surgical intervention suggest skeletal growth is favourable with little evidence of a developing Class III malocclusion. It is hoped that the need for future orthognathic surgery will be reduced.

42 REGULATION OF MASTICATORY FORCE IN THE ANAESTHETIZED RABBIT

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AIMS: To investigate how intraoral and extraoral sensory receptors contribute to regulation of jaw-closing muscle activity and force during mastication.
MATERIALS AND METHODS: Adult male rabbits were anaesthetized with halothane. The masticatory area in the cerebral cortex was electrically stimulated to induce rhythmic jaw movements (CRJMs). EMG activity of masticatory muscles, masticatory force and jaw movements were compared before and during chewing of test strips of varying hardnesses during CRJMs. Five plastic test strips, whose hardness differed almost linearly, were prepared. Muscle spindle discharges were recorded from the trigeminal mesencephalic nucleus during mastication.

	Unilateral		Bilateral		Isolated		Normals	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
SNA	77.6	3.92	82.3	6.4	76.9	3.5	81.4	3.6
SNB	74.0	3.82	74.8	4.7	72.8	3.0	77.7	3.4
ANB	3.7	3.7	7.5	4.9	4.1	2.0	3.7	2.4
MM	29.7	5.4	28.8	7.8	31.5	6.6	25.9	5.4
UAFH	43.1	2.4	43.1	2.8	46.0	3.1	49.4	2.4
LAFH	55.8	3.6	55.8	4.3	57.0	4.2	58.1	3.4
%LAFH	56.4		56.4		55.3		54.0	

RESULTS: Both EMG activity of the masseter muscle and the masticatory force were facilitated during application of a test strip and increased in proportion to its hardness. Similar effects were observed in the animals with loss of intraoral sensations. However, the facilitation was weaker and the rate of rise of masticatory force became significantly smaller after deprivation of intraoral sensation. The Mes V spindle neurons discharged during the jaw-closing phase of a masticatory cycle were rarely observed before application of the test piece. Furthermore, the spindle discharges increased with an increase in the hardness of the test strip.
CONCLUSIONS: The present results strongly suggest that muscle spindles in the jaw closing muscles, as well as intraoral sensory receptors, probably periodontal receptors, contribute to regulation of the masticatory force dependent on the hardness of the substances being chewed.

43 ORTHODONTIC BRACKET PLACEMENT BY AUXILIARY DENTAL PERSONNEL

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AIMS: To determine the precision and accuracy of direct orthodontic bracket placement by qualified auxiliary personnel after limited training.
MATERIALS AND METHODS: Three auxiliary groups (dental nurses, hygienists and technicians) and one consultant orthodontist group, each with five members, participated. The former received 3 hours of initial, followed by 3 hours of advanced, theoretical and practical tuition in orthodontic bracket placement. After each session they bonded 'A' Company straight-wire brackets, using light-cured composite resin, on to malaligned typodont teeth located within a manikin mounted on a dental chair. This was repeated one week later. The control group did likewise but with no prior tuition. After each bond-up the teeth were mounted on a jig and the bracket position recorded relative to root fiducial points using a Reflex Microscope. Horizontal, vertical and in–out linear, and first-, second- and third-order angular bracket position was calculated relative to a previously agreed 'ideal'. The groups were compared using 95 per cent confidence intervals and one-way analysis of variance.
RESULTS: The measurement technique proved valid and precise. The accuracy and precision of auxiliary personnel compared favourably with that of the consultants, although for vertical and second-order angular bracket position the former performed slightly worse and failed to improve significantly with further training. The hygienist group was the least accurate. Precision generally improved more than accuracy. Neither age nor clinical experience affected performance. The auxiliary personnel were fractionally more susceptible to error on rotated and partially erupted premolars.
CONCLUSIONS: Auxiliary dental personnel can attain clinically satisfactory proficiency in direct orthodontic bracket placement after a short training programme.

44 INFLUENCE OF THERMODISINFECTION ON CORROSION OF ORTHODONTIC PLIERS

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AIMS: The increasing number of AIDS and hepatitis infections, combined with new technical possibilities, result in greater demands on hygiene. With the introduction of thermodisinfection the possibility now exists to eliminate micro-organisms on orthodontic pliers. However, it is not clear to what extent thermodisinfection is responsible for the development of corrosion.
MATERIALS AND METHODS: Five samples of four different types of orthodontic pliers from two manufacturers were examined after steam autoclaving and thermo-disinfection. The examination included optical microscopy, scanning electron microscopy and EDX analyses.
RESULTS: Compared with steam autoclaving, more corrosion was found on pliers after thermodisinfection, especially near areas with solder. In the EDX analysis crystallization of Cu and S was detected in these areas. Furthermore, coatings of Na, K, Si, Cl and H^+ were found.
CONCLUSIONS: Only special types of pliers are suitable for thermodisinfection and the quality of the pliers must be improved to avoid corrosion.

Jones M, Pizarro K, Blunden R 1993 The effect of routine steam autoclaving on orthodontic pliers. European Journal of Orthodontics 15: 281–290

45 EFFECTS OF BILATERAL UPPER FIRST PREMOLAR EXTRACTION ON FACIAL HEIGHT AND PROFILE

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AIMS: To evaluate the effects on facial height and profile of bilateral extraction of the first premolars in the upper arch without using any fixed–removable appliances.
SUBJECTS AND METHODS: Twenty-six patients at maximum pubertal growth. Some of the criteria used in the selection of the subjects were Class II molar relationship with normal or mildly increased overjet, existence of mild or no arch length discrepancy in the lower arch, having severe arch length discrepancy in the upper arch and indication for bilateral upper first premolar extraction. The subjects were split into two groups as extraction and control, and each group was matched according to the growth period, ANB and S–N/Go–Gn angle. The mean chronological age was 146.7 months (12 years 3 months) in the extraction group and 146.4 months (12 years 2 months) in the control group. The upper first premolars were extracted bilaterally 2 days after the first records were taken and without any orthodontic treatment The subjects were observed for a mean period of 13.8 months

until the end of pubertal growth (DP3u). The control subjects were observed for a mean period of 16.5 months. The material consisted of 52 lateral cephalograms and hand-wrist radiographs taken from the 26 subjects before and after the study. Eighteen linear, three angular and two proportional measurements were evaluated statistically.
RESULTS: Anterior and posterior facial heights were increased significantly in both groups but no significant difference was found between the groups. The lower anterior facial height increased significantly in both groups, less in the extraction group, and the difference between the groups was significant. The upper one-third of the lower facial height increased significantly only in the controls, and the difference between the groups was found to be significant.
CONCLUSIONS: The extraction of the upper first premolar bilaterally inhibits an increase in the upper one-third of the lower anterior facial height and the lower anterior facial height.

46 EVALUATION OF ORTHODONTIC TREATMENT WITH EARLY EXTRACTION OF FOUR SECOND MOLARS

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AIMS: The outcome of orthodontic therapy with early extraction of four second molars in cases with mild to moderate crowding was evaluated.
MATERIALS AND METHODS: Orthodontic records (panoramic radiographs, cephalograms and plaster casts) of 52 patients (29 females and 23 males) were analysed before (mean age 11.5 years) and after (mean age 14.4 years) treatment with fixed and removable appliances. Fourteen patients were re-evaluated an average of 3 years after the end of treatment. Analysis was computer-assisted using TIOPS software for the cephalograms and plaster casts.
RESULTS AND CONCLUSIONS: Orthodontic treatment with early extraction of four second molars on average did not significantly change the position of the incisors or the soft tissue profile. A holding effect for the upper and lower first molars could be demonstrated, resulting in a net constancy of arch length for both arches. The eruption of third molars was slightly accelerated. The amount of spontaneous space closure and changes of axial inclination of these teeth was not predictable, especially in the lower arch. Follow-up revealed multiple problems with the definitive occlusal positioning of the third molars, making a second phase of treatment necessary in 10 out of 14 cases.

47 DENTAL CROWDING: A COMPARISON OF THREE METHODS OF MEASUREMENT

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AIMS: To explore a new method for the assessment of dental crowding from study models, which would be both valid and reproducible. This was then tested against two previously reported strategies.
MATERIALS AND METHODS: Sixty study models (30 maxillary and 30 mandibular) were measured by a single examiner, on two separate occasions, using a Reflex Microscope and customized computer program, brass wire/callipers and a visual examination technique.
RESULTS: The Reflex Microscope and customized computer program was found to be the most reproducible method, with Pearson's correlation coefficients of 0.97 (upper arch) and 0.92 (lower arch) being recorded. The validity of the technique can only be comparatively assessed in the absence of an absolutely accurate standard of arch measurement. In this respect the mean values recorded for dental crowding using the Reflex Microscope method, in both upper and lower arches, were very close to the average value obtained from the other two methods. The results also indicated that the brass wire and visual examination methods showed a positive bias towards underestimating and overestimating the degree of crowding respectively.
CONCLUSIONS: The Reflex Microscope and its customized computer program provides a valid and reproducible measure of dental crowding and is likely to be of benefit primarily for research and audit purposes where such a method can provide more sophisticated information about the occlusion.

48 REMOVAL OF WHITE SPOT LESIONS BY MECHANO-CHEMICAL METHODS

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AIMS: The purpose of this *in vitro* study was to investigate the alterations on the enamel surface texture caused by application of acid–pumice, micro-abrasion and chemical vital bleaching. All three procedures have been recommended for the treatment of post-orthodontic superficial enamel decalcification.
MATERIALS AND METHODS: The surface enamel of extracted human third molars was treated with the following procedures: (i) vital bleaching with 10 per cent carbamide peroxide ($n = 60$); (ii) abrasion with 40 per cent phosphoric acid applied in a pumice slurry ($n = 32$); (iii) abrasion with 18 per cent hydrochloric acid-pumice ($n = 32$). All methods were used on intact enamel and on tooth surfaces with artificially produced white spots. Surface topography was quantitatively analysed by scanning electron microscopy and enamel hardness was examined according to the method of Vickers. Group differences were statistically proven using the Kruskal–Wallis test.
RESULTS: The peroxide bleaching technique did not lead to any enamel loss but provoked an increase in enamel hardness. This change amounted to 3.1 per cent after the initial application and approached a maximum of 5.5 per cent after the fourth treatment. A single micro-abrasion with the controlled hydrochloride acid-pumice caused a loss of 13.5 μm (±1.6) in specimens with intact enamel and 16.9 μm

(±1.7) in cases of decalcified hard tissue. Tooth structures treated with phosphoric acid–pumice showed a loss of 7.9 μm (±1.5) and 10.6 μm (±1.4) respectively. In cases of repeated acid application the enamel loss was in proportion to the number of treatments. The observed differences were statistically significant.

CONCLUSIONS: Treatment of post-orthodontic tooth surface lesions with acid–pumice or the micro-abrasion technique should be undertaken with great caution as these procedures remove the superficial enamel layers. For improvement of these decalcifications, fluoridation as a non-destructive procedure remains the method of choice. Brownish discolorations may secondarily be removed using the peroxide bleaching method. The observed increase in enamel hardness with this procedure should not be overestimated.

49 AIR-POWDER-POLISHING FOR PROPHYLAXIS IN ORTHODONTICS - EFFECTS ON ENAMEL SURFACES

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AIMS: Patients with fixed appliances often have difficulty in adequately cleaning their teeth which can lead to plaque-induced demineralization. Although motivation and instruction may be sufficient in some patients, professional prophylaxis is the only guarantee in many. This is expensive, however, and in Germany professional prophylaxis is not usually covered by health insurance. Therefore, it seems reasonable to look for efficient measures (in terms of cost/benefit ratio) for cleaning teeth. On the one hand air-powder-polishing devices have been proven to remove plaque effectively, while on the other they are said to be hazardous to enamel. In order to evaluate if air-powder-polishing devices are suitable for routine prophylaxis their abrasive effect on enamel surfaces was investigated.

MATERIALS AND METHODS: Pulps and roots were removed from 150 freshly extracted bovine lower incisors and the crowns were embedded in polyurethane with the labial surfaces uncovered. The labial surfaces were polished on a DPU4 (Struers) polishing automat on silicon carbide discs up to 4000 grit. The teeth were then placed under a thin aluminium plate with a slit of 2 × 7 mm through which the enamel was air-polished for 60 seconds. Three areas per tooth were treated. Four air-powder-polishing devices were tested, each at different settings: (1) Air-Flow SI (EMS), (2) Clean-Jet (Hager & Werken), (3) Prophy Jet (DeTrey/Dentsply), (4) Prophy Unit (Satelec). For each setting 10 surfaces were prepared. Using a laser scanning system (RM600, Rodenstock), several roughness parameters according to DIN 4762, 4768 and 4774 were measured three times per surface. As controls, 10 specimens polished with silicon carbide discs and 10 specimens polished with rotating brushes for 60 seconds with different prophylaxis pastes: (A) RDA 170 (Clean Chemical, Sweden), (B) RDA 250 (Clean Chemical, Sweden), (C) Cleanic (HaweNeos) were used. In addition 20 dentine surfaces were air-polished. Kruskal–Wallis and Mann–Whitney *U*-tests were performed for statistical comparison at $P < 0.05$.

RESULTS: All surfaces air-polished or treated with prophylaxis pastes were rougher than the control specimens. The Clean-Jet device produced rougher surfaces than A and B. With 1, 3 and 4 at maximum setting, enamel roughness was statistically the same or smoother as with A, B and C. It was always significantly smoother at the lowest setting. With 1 and 3 the amount of water in the polishing spray had no significant effect on the resulting roughness. In contrast, changes in the powder adjustment revealed a significant influence on the resulting surface roughness.

CONCLUSIONS: A polishing time of 60 seconds per surface can be considered equivalent to the total cleaning time during a 3-year course of orthodontic treatment if the teeth are air-polished at each appointment. Since the effect of 2 was rather aggressive when compared with the control groups, its application cannot be advocated. On the other hand, the remaining devices (1, 3, 4) can be regularly used without causing more surface roughness than any of the prophylaxis pastes used for comparison, provided the right setting is chosen. Though the effect on enamel seems to be tolerable for routine prophylaxis, air-powder-polishing devices are most aggressive on dentine.

50 A RETROSPECTIVE EVALUATION OF EARLY INTERCEPTIVE TREATMENT CONCEPTS

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AIMS: Controversy and uncertainty surrounds the effect and stability of early interceptive orthodontics and orthopaedics of Class III discrepancies and other dentoalveolar malocclusions. The aim of this retrospective study was to evaluate the objective-result ratio and to analyse the short- and long-term risks and benefits of early intervention.

SUBJECTS AND METHODS: The sample comprised 80 patients aged between 4 and 9 years whose treatment at the Department of Orthodontics, University of Cologne, had begun between 1983 and 1993. Criteria for inclusion was that the interceptive treatment objective should be attained within 2 years and complete records were collected. All available records (documentation of clinical examination and patients' co-operation, pre- and post-treatment models, panoramic films and profile radiographs) were analysed.

RESULTS: Early treatment was completed successfully according to the treatment planning in 63.6 per cent of the patients. In the remainder the stated objectives were achieved over a longer period, the next treatment sequence had to follow immediately or the treatment was not efficient. Several reasons for failure, lack of relative efficacy and relapse were detected: unsatisfactory co-operation, increasing mandibular growth (Class III patients), lack of overcorrection, habits and late beginning of interceptive intervention.

CONCLUSIONS: Early interceptive treatment should commence as soon as possible and the short- and long-term benefits, risks and costs that result from the treatment should be discussed and parents should also be informed of the treatment alternatives.

51 POSITION OF THE LATERAL SEGMENTS OF THE ASCENDING RAMUS IN SAGITTAL OSTEOTOMY

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AIMS: It is known that rotation of the lateral segments of the ascending ramus, including the condylar head and TMJ dysfunction, sometimes occur after orthognathic surgery. In the present study the positional change of the lateral segments were examined after sagittal split ramus osteotomy (SSRO) for skeletal mandibular prognathism.
MATERIALS AND METHODS: Lateral and P-A cephalograms were obtained before (A), within 1 month after (B), and 4–6 months after surgery (C) in patients of the Department of Orthodontics at Tokushima University Dental Hospital. The radiographs were analysed for appraisal of positional change of the lateral segments after SSRO fixed with tandem screw by means of a plate for repositioning of the lateral segments, or with wire but no positioning plate.
RESULTS: (i) The wire fixation group showed further clockwise inclination of the lateral segments from stages A to B, but counter-clockwise from stages B to C. The tandem screw fixation group showed relative stability for each stage. There was no significant change between stages A and C in these two groups. (ii) The wire fixation group showed internal transposition of lateral segments from A to B, and lateral transposition from B to C, whereas the tandem screw fixation group was relatively stable. The wire fixation group showed internal transposition compared with the tandem screw fixation group.
CONCLUSIONS: The tandem screw group with a positioning plate for repositioning of the lateral segments resulted in less positional change of the lateral segments after SSRO than the wire fixation group with no positioning plate.

52 FACEMASK TREATMENT FOR SKELETAL CLASS III MALOCCLUSIONS IN CHILDREN

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AIMS: The effects of a facemask for the correction of skeletal Class III malocclusions were studied in the deciduous dentition and compared with untreated subjects.
SUBJECTS AND METHODS: The facemask group consisted of 25 subjects (17 girls, 8 boys), with a mean age of 4.6 ± 1.3 years at initial observation who were matched regarding age, sex and numbers with an untreated group. Records were taken at the start of treatment and approximately 4 years after the initial records. Differences in cephalometric measurements between the groups were analysed with Student's *t*-test.
RESULTS: A statistical difference between the two groups was observed in the facial axis, SNA and ANB ($P \leq 0.01$), and FMA, saddle angle ($P \leq 0.05$). For linear measurements, Ba–N, XI–Pm and N–Me showed a statistical difference ($P \leq 0.01$).
CONCLUSIONS: Early orthopaedic treatment for skeletal Class III malocclusions using the facemask appliance was effective compared with the untreated Class III subjects.

53 ELECTROTHERMAL AND MECHANICAL DEBONDING: A COMPARATIVE STUDY

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AIMS: The shear forces necessary to remove ceramic brackets using mechanical and electrothermal debonding technique were compared. The post-debond enamel characteristics were evaluated and the temperature rise in the pulp cavity during electrothermal debonding was recorded.
MATERIALS AND METHODS: Human premolar teeth ($n = 90$), were divided into three groups. Each group had a different ceramic bracket type bonded to it (Starfire TMB®, Fascination® and Transcend 6000®). The samples were tested sequentially on a shearing attached to an Instron Universal Testing machine; half the sample were debonded mechanically, half electrothermally (Ceramic Debonding Unit®). The peak shear force at bond failure for each sample and the maximum pulpal chamber temperature rise was recorded. All the teeth were examined under a stereo-microscope and scanning electron microscope for mode of failure (MOF) and an adhesive remnant index (ARI) was scored.
RESULTS: The mean mechanical debonding forces did not differ significantly within the samples of different bracket types ($P > 0.05$). Thermal debonding forces were, however, significantly different from the mechanical forces ($P < 0.05$). There were no significant differences in pulpal temperature rise during electrothermal debonding of the different brackets studied ($P > 0.05$), the mean values ranging from 6.7 to 7.1°C. No enamel tearouts or gross enamel fractures due to debonding were observed. Thermal debonding of Fascination® brackets showed a significant shift to the ceramic–resin interface MOF ($P < 0.01$). The Starfire TMB® group showed a significant shift to the enamel–resin interface ($P < 0.05$) with thermal debonding. Thermal debonding of Fascination® brackets led to a significant increase in the ARI ($P < 0.01$).
CONCLUSIONS: A significant decrease in the force necessary to remove the brackets was observed with thermal debonding compared with the mechanical method. The mean rise in pulpal temperature remained within generally accepted biological parameters. The results for the MOF showed one

cohort with favourable changes, one showing potentially unfavourable changes and one unchanged. There was a significant increase in the ARI score following thermal debonding of Fascination® brackets, but no significant changes with the other two.

54 PAIN AND ANXIETY DURING ORTHODONTIC TREATMENT

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AIMS: To establish the incidence of pain and levels of anxiety experienced during orthodontic treatment.
SUBJECTS AND METHODS: One hundred and twenty-nine patients attending the orthodontic departments at two different hospitals were invited to participate in this study. Written consent was obtained. The subjects completed 'The State-Trait Anxiety Inventory for Children' (Spielberger *et al.*, 1973) and 'The Child Manifest Anxiety Scale' (Reynolds and Richmond, 1978) prior to treatment. Ten Centimetre Visual Analogue Scales (Scott, 1976) were used to assess the pain experienced during treatment sessions. Pain at home was recorded on a pain diary using an Intensity Rating Scale (Keele, 1948). The frequency of oral ulceration, number of analgesics used and other comments were also recorded in the diary.
RESULTS: Mean anxiety scores for this group were similar to established normative values from the general population. No relationship between anxiety and pain was established. All subjects reported at least some degree of pain during treatment. Pain increased to a peak 8–24 hours after bonding and then decreased to baseline levels within 7 days. Males reported higher levels of pain after bonding than females. Sixty-six per cent reported sores or oral ulceration, and 55 per cent used analgesics. Thirty-eight per cent commented on difficulty in eating and 8 per cent needed to take time off school because of pain after bonding.
CONCLUSIONS: All subjects experienced pain or discomfort during orthodontic treatment, but no relationship between anxiety and pain could be found.

Spielberger *et al.* 1973 The State-Trait Anxiety Inventory for Children. Consulting Psychologist Press, Staic Manual
Reynolds and Richmond 1978 The Child Manifest Anxiety Scale. Journal of Abnormal Psychology 6: 271–280
Scott J 1976 Ten Centimetre Visual Analogue Scales. Pain 2: 175–184
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55 SECONDARY ALVEOLAR BONE GRAFTING IN YOUNGER VERSUS OLDER CLEFT PATENTS

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AIMS: To determine if increasing age at the time of secondary alveolar bone grafting in cleft patients would limit the chances of success.
SUBJECTS AND METHODS: Forty-eight consecutively grafted alveolar clefts were assessed pre- and post-operatively utilizing occlusal radiographs. The bone grafting was carried out by one surgeon using autogenous cancellous bone harvested from the iliac crest. The grafts were divided into two samples related to the age at the time of graft; 21 sites from patients aged less than 14 years, and 27 sites from patients aged 14 years or older. The size of the cleft following expansion was assessed, and the degree of bony in-fill after grafting was graded using a four-point scale: grade 1 = >75% in-fill; grade 2 = 50–75 per cent; grade 3 = 50 per cent; grade 4 = no bony ridge.
RESULTS:

Grade of result	<14 years	14+ years
1	67%	30%
2	24%	35%
3	9%	30%
4	0%	15%

Analysis utilizing the Mann–Whitney test determined that the results for the younger age group were significantly better ($P < 0.01$).
CONCLUSIONS: In terms of bony in-fill of the alveolar cleft, secondary alveolar bone grafting in cleft palate patients is more successful in patients aged less than 14 years than in patients aged 14 years and older.

56 ORTHODONTIC PATIENT TRENDS IN A JAPANESE RURAL COMMUNITY

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AIMS: The increase in the development of orthodontic diagnostic methods and materials has made orthodontic treatment common in Japan. This has resulted in an increase in the patient population as well as in orthodontic specialists and dentists. Treatment has not only reached rural areas of Japan, but has grown to include a wide range of age groups, from young children to the middle-aged.
SUBJECTS AND METHODS: The 950 patients used in this study were all residents of Eastern Chiba, an area approximately 100 km east of Tokyo. The statistics were compiled between 1981 and 1995 using treatment records, dental casts, lateral cephalograms and panoramic films. All data were input into two personal computers and compiled with three sets of software.
RESULTS: (i) Patient gender was 40.2 per cent male and 59.8 per cent female. The average age was 11.4 years for males and 12.9 years for females. (ii) Distribution of malocclusions: mandibular protrusion 41.2 per cent, crowding 25.3 per cent, and maxillary protrusion 21.2 per cent. (iii) Angle's classification was Class I 39.3 per cent, Class II division 1 23.7 per cent, and Class III 31.4 per cent. (iv) From the cephalometric

analysis, facial patterns were surveyed. The greatest occurrence was mesiofacial with a tendency to brachiofacial at 24.2 per cent. Both mesiofacial pattern tendency to dolicho and mesiofacial followed at 19 per cent each. Severe brachiofacial occurred in 15 per cent of the cases. Angle's classification and facial patterns combined, Class III and I mesiofacial pattern tendency to brachio; both occurred at 9.9 per cent each. (v) Concerning the anteroposterior relationship of maxilla and mandible, using McNamara's line, retruded maxilla and retruded mandible type occurred in 35 per cent. Using McNamara's line combined with Angle's classification, Class I, retruded maxilla and retruded mandible type occurred the most at 14.1 per cent. (vi) Distribution of extraction/non-extraction cases was 45.2 and 54.8 per cent, respectively.
CONCLUSIONS: These results suggest that the orthodontic patient trends observed in the study are typical of Japanese malocclusions and facial patterns.

57 MASTICATORY PERFORMANCE IN PATIENTS WITH MANDIBULAR PROGNATHISM

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AIMS: To investigate whether the jaw displacement patterns and activity of the posterior temporalis muscle, during chewing in adults with skeletal Class III malocclusions, differ from those in healthy adults with acceptably good occlusions.
SUBJECTS AND METHODS: The subjects consisted of 20 adults with skeletal Class III malocclusion (test group) and 20 adults with acceptably good occlusion (control group). The inclinations of the functional occlusal contacts marked on each posterior tooth at the lateral jaw excursion position were recorded. An assumption was made that the inclination of the functional occlusal tooth contact represented the direction of the occlusal loading during chewing. Thus, each of the upper posterior teeth was categorized into L-B (linguo-buccally directed occlusal force component) and the B-L (bucco-lingually) types. Each of the upper posterior segments was classified into ULB, UBL and Mx types according to whether all the posterior teeth showed L-B type teeth, B-L type teeth or a combination. Unilateral chewing and jaw movement patterns were recorded. EMG records were taken simultaneously from the posterior temporalis muscle bilaterally.
RESULTS: The posterior segments of the control group all exhibited ULB, while those of the test group showed Mx and ULB type. The Mx subsets revealed significantly lower ($P < 0.0001$) incidence of masticatory loops with the jaw-opening trajectories located medial to the jaw-closing trajectories, i.e. the medial-out type chews, when compared with the control group. Significant positive correlation ($P < 0.0001$) was determined between the incidence of the medial-out type chews and the numbers of L-B type teeth. The control and the test group record subsets which had the ULB type posterior segment showed broader medial-out type chews and a significant phase lag of the EMG burst of the contralateral posterior temporalis (CPT) muscle when compared with that of the ipsilateral (IPT) ($P < 0.05$). However, in the test group record subsets which had the Mx type posterior segment, the IPT and CPT muscle started to burst almost simultaneously and showed sharp crest-shaped medial-out and lateral-out type chews, and the jaw-closing velocity in the lateral direction was significantly slower than that of the control group ($P < 0.05$).
CONCLUSIONS: The results suggest that the timing of the posterior temporalis muscle burst is influenced by the direction of the horizontal component of the occlusal load to the posterior teeth during chewing.

58 EVALUATION OF A CHEMICALLY CURED GLASS IONOMER AS A BONDING AGENT

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AIMS: The purpose of this study was to determine the bond strength of a newly manufactured glass ionomer cement when used to bond mesh-backed brackets to enamel surfaces.
MATERIALS AND METHODS: This new glass ionomer cement was developed specifically for the purpose of bonding orthodontic brackets without enamel etching. Commercially available glass ionomer cement (Ketac-Cem, Espe-Premier Dental Products Co., Norristown, PA) and composite bonding medium (Rely-a-Bond, Reliance Orthodontic Products Inc., Itasca, IL) were used as control bonding mediums. All bonding mediums were handled according to the manufacturers' instructions. A special bracket holder was used to grasp precisely the bracket wing during debonding. A universal testing machine (Shimazu Co. Ltd, Tokyo, Japan) was used to measure the tensile bond strength.
RESULTS: The experimental group showed greater bond strength than the control glass ionomer cement group. Cohesive bond failures were only found in the glass ionomer control group, while bond failures at the adhesive–bracket interface were found in both the experimental and control composite bonding medium groups.
CONCLUSIONS: Although the bond strength of the newly manufactured chemically cured glass ionomer cement was significantly less than that of composite bonding medium, the bond strength of this new glass ionomer cement appears to be adequate for clinical use.

59 THE INFLUENCE OF MANUAL THERAPY ON THE THREE-DIMENSIONAL POSITION OF THE MANDIBLE

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AIMS: Following manual therapy, patients frequently report changed occlusal contacts. This study was undertaken to investigate these clinical findings.
SUBJECTS AND METHODS: Twenty-two patients were recorded with a three-dimensional on-line position analysis

of the temporomandibular joints 15 seconds before, during, and 45 seconds after manual therapy of the atlanto-occipital joints. The data were then compared to demonstrate the change of mandibular position by manipulating CO/C1, C1/C2 and C2/C3. Centric recordings were taken before and after manipulating the atlanto-occipital joints. Furthermore casts were mounted by a facebow related to the kinematic hinge axis in an individual adjustable articulator (GIRRBACH Reference)

RESULTS: In all subjects the change of lower jaw position could be demonstrated. A characteristic three-dimensional mobility was registered before and after manipulation. After therapy the mandible mainly moved in an anterior and caudal direction. The occlusal analysis in the articulator demonstrated almost the same movement.

CONCLUSIONS: The findings show that any kind of functional disturbance of the atlanto-occipital joints has an influence on the position of the lower jaw. It is, therefore, necessary to test the functional status of the spine before planning orthodontic or prosthetic treatment. Changing the function of the spine (clinical instability) alters the base of what orthodontists want to influence. Further studies will investigate the relationship that exists related to local findings in the craniomandibular system and to the dysgnathic skeletal positions of the mandible.

60 STATISTICAL EVALUATION OF CLINICAL EFFECTS OF INTRAORAL MOLAR DISTALIZATION ARCHES

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AIMS: To investigate the clinical effectiveness of an intraoral molar distalization method (Wilson) for the treatment of dental Class II relationships.

SUBJECTS AND METHODS: A sample of 36 patients with Class II malocclusion (23 female, 13 male) was used in this investigation. The subjects had either a Class I or II skeletal but bilateral Class II dental relationship. Vertical relationship was the other factor for the selection of the subjects. Individuals having ANS–Me/N–Me greater than 55 per cent, S–Go/N–Me less than 59 per cent or SN–MP angle greater than 38 degrees were not included in this study. Individuals having one of these linear and angular criteria in conflict with other two were omitted. Additionally, care was taken to select subjects without a dentoalveolar mandibular discrepancy and a normal IMPA ($x = 90.33 + 1.44$). Subjects were divided into two groups. Rapid biometric molar distalization arches were applied to the first group which consisted of 21 subjects, while the remaining 15 subjects were taken as controls. The mean age was 13.79 ± 1.3 in the treatment group and 13.28 ± 0.35 in the control group. In the treatment group distalization of molars was performed with biometric rapid molar distalization arches (Wilson) utilizing mandibular anchorage and Class II elastics. Activation of the system was continued until a Class I dental relationship was achieved. The study was carried out on lateral cephalograms of patients taken before and after the observation time, which was 3.49 months in the treatment group and 4.8 months in the control group.

RESULTS AND CONCLUSIONS: At the end of the distalization period a Class II relationship changed to Class I and overbite and overjet improved. After evaluation of lateral cephalograms, unpaired *t*-tests were performed to detect the existence of a statistical significance between males and females, both in the treatment and control groups. After determination of non-significant differences between sexes, the groups were pooled. There was a significant ($P < 0.001$) distal movement (4.14 mm) of the maxillary molars in the treatment group, while the controls showed a significant mesial movement ($P < 0.001$), with the difference between the groups being significant. Due to intrusion ($-0.73 + 0.83$, $P < 0.01$) of the maxillary molars and extrusion of the maxillary incisors ($1.64 + 1.15$, $P < 0.001$), the occlusal plane rotated clockwise. Although the angles SN–OP ($4.33 + 2.61$, $P < 0.001$) and PP–OP ($4.00 + 2.94$, $P < 0.001$) increased, there was no significant increase for the other linear or angular vertical parameters. Mandibular first molars were mesialized ($1.61 + 1.40$, $P < 0.01$) and were extruded with the effect of Class II elastics. This extrusive movement was probably compensated by intrusion of the maxillary molars which resulted in the MP being unchanged during the clockwise rotation of the OP.

61 THREE-DIMENSIONAL CAD SYSTEM FOR SET-UP MODELS

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AIMS: To introduce the outline of a newly developed three-dimensional CAD system for diagnostic set-up models, and its preliminary clinical applications.

MATERIALS AND METHODS: The system is composed of a measuring unit which obtains three-dimensional information from dental casts using laser scanning, and an engineering workstation to generate three-dimensional graphics. The dental cast is projected and scanned with a slit-ray laser beam and point location is determined through triangulation. The measurement error is less than 0.05 mm. The resulting dot map data is relayed to the engineering workstation to generate a three-dimensional image of the dental model. For computed simulation of tooth movement, the representative planes defined by the anatomical medial and distal contact points and the intermediate point between the bucco-cervical and linguo-cervical points are formed for each individual tooth. These representative planes are arranged along a guide line descriptive of the individual arch form. Subsequently, the three-dimensional shape is imported to each of the teeth arranged on the representative plane to form an arrangement of the three-dimensional profile. When necessary, orthognathic surgery may be simulated by moving

the mandibular dental arch three-dimensionally to establish a Class I occlusal relationship.
CONCLUSIONS: It takes 150 minutes to generate a three-dimensional graphic image of the dental model and 40 minutes to generate the set-up model graphic image using a 0.25 mm scanning pitch. Compared with hand-made set-up models, the computer model has advantages such as high-speed processing and quantitative evaluation on the amount of three-dimensional movement of the individual teeth relative to the craniofacial plane. Trial clinical applications have demonstrated that the use of this system facilitates the otherwise complicated and time-consuming mock surgery used for treatment planning in orthognathic surgery.

62 IMPROVING ORAL DEVELOPMENT WITH THE HOTZ PLATE AND CHEWING TYPE NIPPLES

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AIMS: Development of masticatory function is usually insufficient in cleft palate infants because of difficulty in feeding (Jones, 1988). It is difficult for these babies to suck, and intubation feeding is often applied in the early stages after birth. Masticatory muscles fail to mature and the early development of function is inhibited. Recently a new type of nipple, from which the milk flows out by chewing action, but not by sucking, controlled by a pair of semilunar valves, was developed in Japan (Otsuka Pharm. Co.). A trial to use this nipple with a modified Hotz plate showed that the cleft palate babies could ingest the milk easily using their own muscle actions. In the present study an attempt was made to evaluate the oral development of these infants in comparison with non-cleft infants.
SUBJECTS AND METHODS: Forty-eight cleft palate infants, with a modified Hotz plate and fed by bottle with the chewing type nipples (group A). The controls were three groups of non-cleft infants fed with chewing type nipples (group B), breast fed (group C) or fed with regular sucking nipples (group D). For the scale of comparison, a newly designed chart showing chewing ability for 20 varieties of food was used (Sakashita *et al.*, 1994).
RESULTS: The chewing ability index of group A at 3 years of age was 263.7, while those of the three control groups were 316.6, 262.3 and 244.1, respectively. There were significant differences between groups B and A ($P < 0.05$), group C ($P < 0.01$) and group D ($P < 0.001$), and between groups C and D ($P < 0.05$), while there was no significant difference between groups A and C, nor between groups A and D. This means that the group A achieved almost the same degree of development as the breast-fed infant.
CONCLUSIONS: Whilst it is necessary to investigate the ability of cleft palate infants fed by intubation or only by the regular sucking type nipples, it would appear that the use of the combination of modified Hotz plate and chewing type nipple seem effective in improving oral development.

63 *IN VITRO* CORROSION OF ORTHODONTIC WIRES USING THE STATIC IMMERSION TEST

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AIMS: To evaluate the *in vitro* behaviour of orthodontic wires under severe corroding conditions and compare the resulting biodegradation among the tested wires and the different alloy groups.
MATERIALS: Eighteen orthodontic wire products were used. Two were examined in hard and spring-hard form and four as 'straight' (as received) and 'bent' samples (after repeated bending of the material with three-prong pliers). Two identical sets of these 24 specimens were formed.
METHODS: Every sample, with a total surface area of 15.38 cm^2, was placed into a container with 20 ml of an aqueous solution comprising 0.1 mol/l lactic acid and 0.1 mol/l NaCl, resulting in a ratio of 1.3 ml solution per cm^2 of test specimen surface area [according to ISO 1562:1993(E), Annex A]. The containers were firmly sealed and kept at 37°C for 7 days. The wires remained in the solution for 24 hours (day 1), were then immersed in new solutions for 3 days (days 2–4) and this procedure was repeated for the remaining 3 days (days 5–7). These solutions were ultimately analysed for traces of the alloying metals of each sample using inductively coupled plasma atomic emission spectrometry. In addition, the surface topography of the corroded wires was examined qualitatively by scanning electron microscopy.
RESULTS: Daily corrosion rates reached peak levels after day 1 and diminished thereafter due to passivation of the alloys. Between the basic alloy groups, the CoCr wires (Elgiloy) and β-titanium wire (TMA) presented the best chemical properties. NiTi wire products also presented high corrosion resistance with the exception of 'Original Chinese NiTi'. The chemical stability of the CrNi stainless steel wires varied considerably between the tested products: nickel-reduced steel wires released extremely low amounts of nickel, but the manganese release was much higher. Among the multistranded wires, 'Wildcat' proved to be the least resistant to corrosion. Furthermore, hard and 'straight' wire types were advantageous compared with spring hard and 'bent' wire types respectively.
CONCLUSIONS: Most of the orthodontic wires showed acceptable resistance to corrosion, although the degree of susceptibility varied among the specimens investigated. This fact should be taken into consideration when choosing between wires with similar mechanical properties, and particularly for use in patients with known allergies.

64 CEPHALOMETRIC FLOATING NORMS FOR THE POSITION OF THE LOWER INCISORS

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AIMS: The orientation of the mandibular incisors to the rest of the facial skeleton has long been recognized as a useful guide in the diagnosis and treatment of malocclusion. The aim of the investigation was to present a method of describing the position of mandibular incisors in individuals with different interbasal (ML–NL), and occlusal-mandibular angles (Ocp–ML). The results can also be used as guidelines for positioning of upper and lower incisors in complete dentures.

SUBJECTS AND METHODS: Eighty lateral cephalometric radiographs of untreated individuals over 16 years of age (37 males, 43 females) with ideal occlusions (Class I, harmonious soft tissue profile, complete dentition) were obtained. The following angular measurements were performed on lateral cephalograms: (i) NL–ML, (ii) Ocp–ML and (iii) T–ML. Minimum, maximum and mean values, as well as standard deviations of each variable, were calculated. Statistical analysis of the recorded data comprised calculation of Pearson's correlation and linear and multiple regression analysis, calculated to describe the associations between the variables.

RESULTS: Significant correlation coefficients ($r = 0.60$, $r = -0.35$, $r = -0.52$) between the cephalometric variables were assessed. A graphical box was constructed on the basis of the correlation between the variables, which should enable the operator to determine if the association between variables is harmonious. Any horizontal line connecting the values of the cephalometric variables inside the box was considered as an expression of an harmonious pattern. In the vertical middle of the box the mean values of the variables were listed on a horizontal line. If all the values of a patient fall within the borders, the combination of values can be considered more or less harmonious.

CONCLUSIONS: Floating norms show that in cases with ideal occlusion and harmonious profile the basal and dentobasal characteristics can vary greatly. The graphical box provides satisfactory guidance for the position of the lower incisors in relation to the mandibular plane in individuals with different interbasal and occlusal–mandibular angles, which can also be used in prosthetic dentistry.

65 MUSCLE FUNCTION DURING MULTI-STAGE ACTIVATION OF MODIFIED HERBST APPLIANCE TREATMENT

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AIMS: This research investigated the step-by-step bite jumping effect of a modified cast splint Herbst appliance on masticatory muscles by means of surface electromyography (EMG).

SUBJECTS AND METHODS: The experimental group consisted of 10 consecutive southern Chinese subjects, age 10–15 years with a Class II division 1 malocclusion treated with a Herbst appliance for 6 months. A modified cast silver splint Herbst appliance design was used, with multi-stage activation of the appliance at a rate of 2 mm per 2 months. The function of the superficial masseter muscles and anterior portion of the temporalis muscles was monitored with the K6-I-Cranio-Mandibular Diagnostic System (Myotronics, Inc. Seattle, WA), with regard to maximum bite force at (i) incisal edge-to-edge, and (ii) retruded mandibular positions, both at an inter-incisal separation of 3 mm. Measurements were taken pre-treatment, at 2 weeks and every 2 months following appliance insertion.

RESULTS AND CONCLUSIONS: The results suggested that by 2 months following appliance activation, the two masticatory muscles investigated showed signs of recovery from and adaptation to the initial functional disturbance as well as some improvement in the balance of muscle function.

66 OPEN SEMI-FLEXIBLE ACTIVATOR (OSA) AND SKELETAL OPEN BITE

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AIMS: To investigate a new elastic activator, the Open Semi-flexible Activator (OSA), in the treatment of skeletal open bite.

MATERIALS AND METHODS: This appliance is a modification of the Bionator. The acrylic between the occlusal surface was replaced by a thermoplastic elastomer resin. The elastic substance inserted between the dental arches allows good utilization of the active and passive muscular tensions. In this preliminary study 10 patients with skeletal open bite were treated with the OSA for 2 years. The appliance was worn for 14 hours a day and 12 clenching exercises, with the appliance in the mouth, were practised three times a day for a period of 3 months. The results were evaluated clinically, electromyographically and cephalometrically. The electromyographic evaluation was undertaken in correspondence to the masseter and the anterior bundle of the temporal muscles during the mandibular rest position and maximum clenching.

RESULTS: After 2 years of treatment eight patients displayed increased electromyographic activity during maximum clenching; only four patients demonstrated a moderate modification of the muscular postural activity. The clinical examination indicated a remarkable improvement in neuromuscular behaviour, and cephalometric analysis showed a slowing down of the dentoalveolar growth in the posterior part of the dental arches. In eight subjects the gonial angle did not increase; it decreased in two subjects and four patients demonstrated a clockwise movement of the maxilla.

CONCLUSIONS: The elastomer resin utilized in the OSA on the occlusal surface of the dental arches is effective when an increase in the activity and tension of the masticatory muscle

during the therapy of skeletal open bite is required. The OSA results in dental and skeletal modifications, but further research is required in order to understand the way in which the OSA works.

67 THE HANNOVER INTERDISCIPLINARY TREATMENT FOR BCLP PATIENTS

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AIMS: To describe the Hannover treatment approach and to evaluate metrical changes in lateral cephalometrics and upper jaw casts.

SUBJECTS AND METHODS: Forty-eight patients with bilateral cleft lip and palate (BCLP), born between 1980 and 1995, were reviewed. Mean times for labioplasty and palatoplasty were determined and the beginning, end and duration of pre-surgical orthodontic treatment was evaluated. Sagittal, vertical and incisor changes from the early mixed to permanent dentition were compared from lateral cephalograms. A self-developed method for measuring upper jaw casts was used to analyse positional changes of the three portions of the cleft palate during craniofacial growth.

RESULTS: According to the Hannover treatment regimen, lip closure after Veau-Cronin is carried out at 6.02 ± 2.25 and 7.33 ± 2.34 months, closure of the hard palate after Pichler at 29.95 ± 3.83, and closure of the soft palate after Widmaier at 34.04 ± 4.73 months. Pre-surgical orthodontic treatment starts at 0.49 ± 0.21 months, ends at 26.14 ± 7.66 and lasts 25.70 ± 7.46 months. Lateral cephalographs show that postnatal Class II relationships can be altered towards Class I ($P < 0.01$). Concave facial profiles and skeletal Class III relationships do not occur. Vertical changes can only be found as a change of the mandibular inclination ($P < 0.05$). The maxilla remains distally inclined. The upper and lower incisors are always retroclined. The inclination is significantly ($P < 0.05$) changed during treatment but does not reach physiological ranges. The upper jaw cast measurements indicate that the inclination of the anterior lateral parts change significantly ($P < 0.01$) from birth to the late mixed dentition. The torsion of the premaxilla is altered towards physiological ranges ($P < 0.01$).

CONCLUSIONS: After 15 years of interdisciplinary treatment experience, the Hannover approach has proved to deliver stable and physiological results. These results obviate the need for BCLP patients to undergo further surgical correction.

68 CONDYLAR POSITION IN ORTHOPAEDIC TREATMENT OF CLASS III MALOCCLUSION

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AIMS: To evaluate condylar position on corrected lateral tomograms in patients wearing an orthopaedic facemask.

SUBJECTS AND METHODS: The sample consisted of 22 patients (10 males, 12 females) with Class III dental and skeletal malocclusion, retrusion of the maxilla and no signs or symptoms of TMJ dysfunction. The mean age was 8.3 years (range 6.8–9.2 years). The patients were treated with reverse headgear (450 g/side). Corrected lateral tomograms of the left and right temporomandibular joints before (T_0) and after the application (T_1) of the reverse headgear were compared. The anatomical structures of the T_0 tomogram were traced on acetate paper and then transferred to the T_1 tomogram using Porion and the top of glenoid fossa as references for superimposition. Differences between T_0 and T_1 posterior joint space (PJS), superior joint space (SJS) and anterior joint space (AJS) were measured according to the method of Athanasiou (1992). To assess possible significance of differences, Student's t-test for paired comparison was performed.

RESULTS: No significant statistical differences were found between T_0 and T_1 as far as posterior, superior and anterior spaces were concerned (Left TMJ: PJS $\bar{d} = -0.21$, $t = -1.86$; SJS $\bar{d} = -011$, $t = -1.99$; AJS $\bar{d} = -0.01$, $t = -0.16$. Right TMJ: PJS $\bar{d} = -0.18$, $t = -1.50$, SJS $\bar{d} = -0.15$, $t = -1.61$; AJS $\bar{d} = -0.03$, $t = 0.48$). The differences ranged from −1 to 1 mm for PJS and SJS and from −1 to 0.5 mm for AJS.

CONCLUSIONS: The results of the present study seem to indicate that in Class III patients treated with a facemask the orthopaedic force applied is unable to drive the condyle distally. However, the long-term effects on condylar position in patients wearing orthopaedic facemasks should be studied.

69 EFFECTS OF ORTHODONTIC/ORTHOPAEDIC APPLIANCES INDEPENDENTLY FROM GROWTH

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AIMS: This study forms part of a series where the variability of effects due to specific orthodontic/orthopaedic appliances were investigated. For this purpose similar investigations were conducted, each of them considering a single appliance. The aim was to test the effects of different orthodontic/orthopaedic appliances by means of the same computer-aided software, developed in order to provide information on the magnitude and pattern of dental and skeletal changes, independently from growth.

METHODS: A standardized method was developed to compare different appliances by observing their influence on the variation of cephalometric parameters with respect to norm and harmony in a dimensionless perspective. The computer-aided method of investigation was based on the use of CDU (clinical deviation unit) as a measurement unit. This has the following advantages: (i) CDU is a 'dimensionless', versatile parameter suitable for comparison of several variables regardless of age, sex, appliance, treatment length, skeletal typology or type of malocclusion. (ii) All considered cephalometric variables, linear and angular, are comparable and can be sorted on the basis of their relevance. (iii) The

method is extremely simple and applicable to a wide variety of research purposes. Dimensional fluctuations of cephalometric parameters or the unreliability of superimpositions on growing skeletal structures were in this way avoided. In this study the variability of effects due to Sander's BJA (Bite Jumping Appliance) were investigated and are described in relation to sex, age and treatment length on a double sample of 20 German and 30 Italian treated subjects.

CONCLUSIONS: (i) The BJA is able to accelerate growth potential: the sample shifts, on the whole, towards auxologic classes related to higher cell proliferation. The appliance was capable of eliciting growth modification simply by recombining pre-existing intraoral forces (i.e. a real functional appliance). (ii) The BJA does not always produce the same therapeutic effects: depending on sex, age and treatment length, the prevalent effects are not constantly observed for the same cephalometric parameters—ramus and mandibular length, for instance, consistently improved long before puberty in females, while during it in males. (iii) The sole use of the BJA is able to control the excess of maxillary forward growth in females at all ages. In males additional use of extraoral forces could be indicated in early treatment. (iv) Interceptive treatment is indicated for females (9–11 years of age), particularly in those cases where a Class II relationship is associated with ramus height deficiency (post-rotational cases) or short corpus length (micro-mandibular cases).

70 SOFT-TISSUES CHANGES RESULTING FROM CLASS III BIMAXILLARY SURGERY

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AIMS Soft-tissue response to combined maxillary advancement and mandibular setback surgery was evaluated and statistically correlated to hard-tissues movement.

SUBJECTS AND METHODS: Radiographs of 16 skeletal Class III subjects (2 males, 14 females with a mean age of 22.3 years) taken at T_0 (before treatment). T_1 (immediately before surgery), T_2 (immediately after surgery), T_3 (at debanding), T_4 (2 years after surgery) were examined. Orthodontic treatment was performed with a segmented technique combined with surgical mandibular setback and maxillary Le Fort advancement.

On the T_0 tracing, a constructed Frankfort horizontal, 7 degrees from the S–N line, was established as the horizontal reference line. A line perpendicular to the constructed Frankfort horizontal, passing through Nasion, was used as the vertical reference line. The tracings following T_0 were then superimposed onto the first one (using anterior cranial base as a reference line) and the two reference lines were transferred. Displacements of the main hard-tissue points as well as corresponding soft-tissue points were measured at each T. T_1–T_0 indicates the orthodontics effects, T_2–T_1 the surgical effects, T_3–T_0 the short-term combined treatments effects, T_4–T_0 shows the long-term treatment effects, T_4–T_3 the post-treatment final relapse. Correlation between hard and soft tissue points was evaluated and analysis of linear and multiple regression was carried out to highlight the predictability of movement of dependent variables (soft-tissues), following one or more independent variables (hard-tissues).

RESULTS: The following results seem to be the most interesting: (i) soft tissues showed an anterior sagittal movement larger than hard tissues at T_2, but the different behaviour of hard and soft tissues decreased at T_4; (ii) displacement of soft tissues close to the mandibular symphysis was the most predictable with a relationship to bone points near to 1:1; (iii) a slight relationship between movement of point A and upper lip points was demonstrated; (iv) high significant correspondence between upper labial points and Stomion (soft tissue) on one side and incisor dental points and Prosthion (hard tissue) on the other side was found.

71 DEVELOPMENT OF THE TEMPORO-MANDIBULAR JOINT AND MIDDLE EAR IN HUMAN FETUSES

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AIMS: To analyse the fibrous connection between the middle ear and temporomandibular joint during fetal development.

SUBJECTS AND METHODS: Ten human fetuses from the collection of the Institute of Anatomy and Embryology were studied by optical microscopy. The specimens ranged from 35 to 300 CR (crown–rump) length. The fetuses were preserved in 10 per cent neutral formalin and then perfused with paraffin. Serial sections of 10 μm were sliced on the three spatial planes. The slices were stained according to Lillie's and Weinghort's techniques.

RESULTS: During human fetal development Meckel's cartilage was observed passing through the tympano-squamosal fissure and continuing into the middle ear with the cartilaginous anlage of malleus. A condensation of mesenchymal tissue surrounded this cartilage. The microscopic observations identified several relationships between the temporomandibular joint and middle ear, i.e. the sphenon-mandibular ligament, the anterior ligament of malleus and the discomalleolar band. The first and second ligament form a single fibrous structure. The third one rising from the posterior fibres of the temporomandibular disc joins the anterior ligament of malleus.

CONCLUSIONS At least three fibrous connections can be observed between the temporomandibular joint and middle ear, and both Meckel's cartilage and mesenchyme that surrounds it give rise to these fibrous connections. These embryological relationships may explain, from a clinical point of view, the frequent involvement of the middle ear in TMJ disease.

72 DEMINERALIZATION ASSOCIATED WITH PRECOATED AND CONVENTIONAL BRACKET SYSTEMS

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AIMS: Post debonding demineralization has been reported to affect at least one tooth in 50 per cent of patients. Removal of flash and minimal loading of the bracket are two methods which have been suggested to reduce this occurrence. One of the reported advantages of precoated brackets is that they lead to reduced flash. This study examines whether the use of precoated brackets leads to a reduction in white spot formation.

SUBJECTS AND METHODS: Thirty-eight patients were originally randomly allocated to either a study group using precoated brackets, or a control sample using a conventional sandwich one-paste system. Full records were available for 22 patients and these comprised the study sample. Pre- and post-treatment photographs were examined for the presence of white spots. A total of 165 teeth were included in the study group and 164 teeth in the control sample. To assess the reliability of photographs in detecting white spots, 125 teeth in 10 subjects were examined photographically and clinically. There was a 90 per cent inter-method agreement, which was considered acceptable

RESULTS: Pre-treatment, 20 of the teeth in the control sample had white spots, giving a prevalence of 12 per cent. This increased to 23 per cent (38) post-treatment. In the precoated sample, although only 8 per cent (14) displayed white spots pre-treatment, 24 per cent (40) of teeth showed post debonding white spot formation. The severity of the white spots were also examined using the opacity index (Curzon and Spector, 1977). This increased from 0.022 to 0.048 in the control group and from 0.011 to 0.029 in the test sample.

CONCLUSIONS: There appears to be a slight increase in demineralization associated with the use of the precoated system.

73 CLEFT LIP AND/OR PALATE CHILDREN IN WESTERN IRELAND

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AIMS: The aims of this study were to identify children born with cleft lip and/or palate in the region since 1980, to identify their surgical management, and to assess their dental and orthodontic needs. The West of Ireland comprises three counties—Galway, Mayo and Roscommon—with a population of 343 246. The region's annual live birth rate has fallen significantly in the last 25 years, with a birth rate of 5754 in 1993 compared with 7935 in 1980.

SUBJECTS AND METHODS: Information was gathered from all dental clinics in the region, from the plastic surgery unit, the speech pathology department and the two paediatric departments servicing the region. Clinical and radiographic examinations were carried out to identify the patients' dental and orthodontic status.

RESULTS: Seventy-three children were identified with some form of cleft lip and/or palate: 43 were males and 30 females. Twenty-six (36 per cent) were cleft palate (CP) and 47 (64 per cent) had cleft lip and palate (CLP). Within the CP group, there were 10 males (38 per cent) and 16 (62 per cent) females, while in the CLP group there were 33 (70 per cent) males and 14 (30 per cent) females. Within the CLP group, left-sided cleft predominated with 23 (49 per cent) versus 9 right-sided (19 per cent). Fourteen (19 per cent) were syndromic and 59 (81 per cent) non-syndromic. Of the syndromic group, 6 (43 per cent) had classifiable craniofacial syndromes. Twenty-six (36 per cent) children had a history of recurrent ear infections, while 9 (12 per cent) had actual hearing loss. Family history was recorded in 28 (38 per cent) of cases. Six centres with six different surgeons were involved in surgical repair of these children, with one surgeon involved in the surgical care of one patient. The maximum number of patients treated by a single surgeon was 21. The dmf was 3.1, and DMF 2.35. Adjacent to the cleft site, the lateral incisor was absent in 26 (36 per cent) children, 6 (8 per cent) had a dilacerated central incisor and 20 (27 per cent) had a hypoplastic central incisor. The most common orthodontic malocclusion was Class I, 39 (53 per cent).

CONCLUSIONS: While variations existed within the three counties, the overall findings reflect similar trends internationally. The lack of a centralized structure to regulate the care of these children is reflected in the large number of plastic surgeons involved in the care of a small group of patients.

74 RELATIONSHIP BETWEEN BITE FORCE AND FACIAL ASYMMETRY IN UCLP

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AIMS: The relationship between craniofacial patterns and masticatory functions in unilateral cleft lip and palate (UCLP) patients has remained obscure. The aims of this study were to assess the relationship between the bite force distributions over the dental arches and the craniofacial morphology, especially facial asymmetry, in UCLP patients, using postero-anterior cephalograms.

SUBJECTS AND METHODS: Twelve UCLP patients (nine boys, three girls; mean age 15 years 2 months) were selected from the orthodontic clinic of Niigata University Dental Hospital. The degree of maximal bite force and the area of occlusal contacts were measured using a pressure-sensitive sheet (Occlusal Prescale, Fuji Photo Film Co.) and analysing system. Linear and angular measurements from postero-anterior cephalograms were also calculated.

RESULTS: The average maximal total bite force and occlusal contact area were 36.1 kgf and 7.0 mm^2. The percentage of the bite force borne by the molar regions was 75.4 per cent. The bite force detected at the molar region on the cleft side

was significantly greater than the non-cleft side. The widths of the maxillary basal bone and the antegonion of the mandible were significantly wider on the cleft side than on the non-cleft side, while menton deviated to the cleft side. The bite force correlated with the cleft-sided inclination of the maxillary basal bone. The cleft side/non-cleft side occlusal force ratio and the deviation of menton also correlated.
CONCLUSIONS: These results suggest that the maxilla and the mandible tend to deviate to the cleft side, and an imbalance of occlusal force on mastication between the cleft side and the non-cleft side occurring during growth would be an exacerbating factor for facial asymmetry in UCLP.

75 SPACE ANALYSIS: COMPARISON BETWEEN SONIC DIGITIZATION AND DIGITAL CALIPERS

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AIMS: To compare the validity and reproducibility of tooth width and arch perimeter values, on plaster casts, using the Dolphin Imaging System's sonic digitization and digital calipers.
MATERIALS AND METHODS: Forty-seven sets of plaster casts of southern Chinese children (aged 12 years) comprised the sample. Arch perimeter was measured in six segments, from the first molar to its antimere on each arch, and summed according to Lundström (1949). The total mesiodistal widths of all teeth, excluding second and third molars, were measured and summated. The difference between the available arch perimeter and the total tooth widths was taken as the arch perimeter discrepancy. The measurements were recorded twice, 1 week apart, by a single examiner. *t*-tests were used to compare the results of the two methods.
RESULTS: Compared with the manual measurement method, there was a consistent overestimation of the total tooth widths by sonic digitization. In the mandible, the arch perimeter and arch perimeter discrepancy were significantly different ($P < 0.007$, $P < 0.001$), with the sonic method consistently underestimating (1 per cent, 22 per cent). However, there were no statistical differences detected between the two methods on the maxilla.
CONCLUSIONS: Sonic digitization is not as reproducible as the digital caliper. There was a larger variation when measuring individual tooth widths using the sonic method. The measurements from the sonic method in evaluating space problems should be interpreted with reservation.

76 EFFECT OF DENTAL STIMULATION IN THE RAT BRAIN

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AIMS: To investigate the effects of dental stimulation on the secretion of serotonin and the expression of the c-*fos* oncogene protein in the rat brain.
MATERIALS AND METHODS: The maxillary first molar was extracted unilaterally in adult male Wistar rats under sodium pentobarbital anaesthesia. Two hours later the rats were anaesthetized, perfused with 0.9 per cent NaCl and 4 per cent paraformaldehyde and the brain was removed and fixed in 4 per cent paraformaldehyde solution for 2 days. The tissue was sectioned at a thickness of 30 μm on a vibratome and immunostaining for serotonin and fos, the nuclear protein product of the c-*fos* gene was carried out.
RESULTS: In the experimental rats, serotonin-immunoreactivity after dental stimulation showed an increase in the midbrain. Many c-*fos*-like immunoreactive cell bodies were observed and there was an increase in the number of fos-positive neurons in the rat forebrain.
CONCLUSIONS: The results suggest that dental stimulation increases the secretion of serotonin and the expression of c-*fos* oncogene protein in the rat brain.

77 CHARACTERISTICS OF CRANIOFACIAL MORPHOLOGY IN CASES WITH ANTERIOR CROSSBITE

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AIMS: To investigate morphological characteristics of the craniofacial skeleton before orthodontic treatment in patients with an anterior crossbite.
SUBJECTS AND METHODS: Ninety-three female patients with an anterior crossbite examined during a 5-year period from 1985 to 1990 were classified into three age groups: 7–9, 9–11 and 11–13 years. Each age group was further divided into three groups according to ∠ANB: group X, Skeletal I before treatment and after pubertal growth spurt; group Y, Skeletal III before treatment and Skeletal I after pubertal growth spurt; and group Z, Skeletal III before treatment after pubertal growth spurt. Cephalograms before treatment were analysed to compare with the control group of Japanese females collected by the Department of Orthodontics, Faculty of Dentistry, Osaka University. The data from cephalograms in the groups X, Y and Z were also compared with each other.
RESULTS: (i) Anterior crossbite cases had a large Go–A and protruded chin, compared with those of normal occlusion cases. There was no difference among groups X, Y and Z. (ii) Group X had a normal size and position of the maxilla; Group Y had a normal position and underdevelopment of the maxilla; and Group Z had a retruded and significantly underdeveloped maxilla. (iii) Patients with anterior crossbite had an overdeveloped and protruded position of the mandible, compared with those of normal occlusion. There was no difference among groups X, Y and Z. (iv) In the anterior–posterior relationship between maxilla and mandible, groups X and Y showed a normal position of point A

and a protruded point B. Group Z showed a retruded point A and a protruded point B.
CONCLUSIONS: In patients with a Skeletal III malocclusion with retrusion and undergrowth of the maxilla, treatment is extremely difficult.

78 IMMUNOHISTOCHEMICAL AND ULTRASTRUCTURAL STUDY OF THE VASOMOTOR NERVES IN THE MICROVASCULATURE OF RAT PERIODONTAL TISSUE

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AIMS: To examine the relationship between the changes of blood flow and vasomotor nerves following experimental tooth movement in periodontal tissue immunohistochemically and ultrastructurally in rats.
MATERIALS AND METHODS: One hundred and forty 7-week-old male Wistar strain rats were used. Orthodontic elastics were inserted between the crown of the first and second molars of the upper jaws, using Waldo's method. The animals were killed 12 hours, 1, 3, 5, 7 and 14 days after the insertion of the elastic. Immunohistochemical procedures were carried out with the streptavidin–biotin peroxidase technique using a streptavidin–biotin kit. The sections were lightly counterstained with 1 per cent methyl green. Ultra-thin sections were stained with uranyl acetate and lead citrate, and examined in a JEM 1200EX electron microscope.
RESULTS: *Light-microscope findings:* Immunohistochemistry for S-100 protein and NSE showed almost identical staining patterns on periodontal nerves in serial sections. Many arterioles were accompanied by nervous tissues on the non-pressure side, but substantial numbers were devoid of perivascular nervous tissues on the pressure side in the early periods of tooth movement. *Ultrastructural findings:* Both myelinated and unmyelinated nerve fibres were observed around the microvessels, especially around arterioles. The diameter of the unmyelinated fibres was significantly smaller than those of the myelinated on the pressure side in the early periods of tooth movement.
CONCLUSIONS: These findings suggest an intimate structural association between vasomotor nerves and arterioles in regulating the arteriolar microcirculation in periodontal tissue by stimulating smooth-muscle cells following orthodontic tooth movement.

79 EFFECT OF REDUCING OVERBITE ON ORAL MOVEMENTS DURING SPEECH

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AIMS: To use a video recording and measuring technique to assess the effect of reducing the overbite in a group of normal speaking adults on the movement of the lips and mandible during speech. The study also assessed the effect when the vertical increase is maintained, and overbite is artificially restored to its original dimension.
MATERIALS AND METHODS: Study models of nine volunteers were mounted on an articulator, and the overbite reduced to an edge-to-edge vertical relationship using acrylic onlays over posterior teeth. Anterior onlays were constructed on the maxillary and mandibular teeth to restore the original overbite. Dark glass bead landmarks were fixed to the upper lip, lower lip and chin, to record soft tissue movements, and a similar bead was fixed to rectangular wire ligated to a bracket cemented to the mandibular right canine to record mandibular movements. Video recordings of the subjects reciting standard nonsense words were obtained under three conditions: (1) normal, (2) with the posterior onlays and (3) with posterior and anterior onlays. The vertical movements of the four landmarks were plotted against time using a video position analyser.
RESULTS: The mean vertical displacement of the landmarks under condition 2 was reduced when compared with conditions 1 and 3, although condition 3 was also associated with a reduced mean displacement of landmarks. The subjects took progressively longer to complete the nonsense words moving from condition 1 to condition 3.
CONCLUSIONS: The speech movements of the soft and hard tissues are altered when the intraoral vertical dimension is altered, and there are changes in the movements back towards those of the original condition when the original overbite is prosthetically restored. The changes observed can be explained by the theory of motor equivalence. This equipment would have application to other disciplines.

80 TEMPOROMANDIBULAR DISORDERS OR DEVELOPMENTAL VARIATION IN ADOLESCENTS?

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AIMS: This study is the third part of a longitudinal investigation on associations among different orofacial dysfunctions and development of occlusion.
SUBJECTS AND METHODS: In the present study signs and symptoms of temporomandibular (TM) disorders, mandibular movements RP–IP slide, occlusal interferences and malocclusion were recorded in 15 year-old adolescents (n = 185). The subjects were asked if they had had any orthodontic treatment, suffered trauma in the orofacial area or favoured unilateral chewing. In addition, oral motor skills of the subjects (90 girls, 95 boys) were examined by an experienced phoniatrician.
RESULTS: Logistic regression models revealed that girls were more likely to have jaw deviation on opening, palpatory tenderness of the masticatory muscles and headache than boys. Deviation on opening was found most often in the youngest group of this age cohort. This sign was also associated with asynchrony of condylar movement and with

problems in oral motor skills. The morphological traits of occlusion that were related to certain TM-disorders were mesial molar occlusion, combination of occlusal interferences and large overjets; the former increased the risk for headache and the latter the risk for jaw hypermobility. Regarding the anamnestic information, only previous traumas were related to muscle tenderness.
CONCLUSIONS: It seems that among young adolescents certain signs and symptoms of TM disorders reflect different aetiological factors, both local and central, and thus developmental variation should be differentiated from pathological changes.

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81 A NEW SYSTEM FOR MECHANICAL STIMULATION OF CYTOSKELETAL BINDING SITES

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AIMS: Orthodontic tooth movement is the basis for clinical correction of a malocclusion. Although many studies have been undertaken to examine this phenomena, there is still controversy regarding the magnitude and direction of orthodontic forces and especially about the signal transduction mechanisms, i.e. transduction of a mechanical orthodontic signal into a metabolic signal within the cell. Many experimental systems for mechanical stimulation of cells *in vitro* have been presented in the past decade (Schaffer *et al.*, 1994). All these systems have a greater or lesser degree of basic disadvantages (shear stress, indefinable forces, fluid flow phenomena). The objective of this investigation was to introduce a new system for experimental mechanical stimulation of PDL fibroblasts on the basis of magnetic immunomicrospheres (MIMS) and inhomogeneous magnetic fields.
MATERIALS AND METHODS: For all experiments human PDL fibroblasts from an extracted premolar were used. Cells were incubated under standard culture conditions until the second passage. For the preparation of MIMS, albumin was used as a matrix and ferric oxide as incorporated magnetic particles. Subsequently the surface was activated by using cross-linkers and coupled to antibodies against α_2- (P1E6), α_3- (P1B5) and β-integrin (P4C10). Cells of the second passage were incubated with MIMS for 30 minutes at 37°C. For mechanical stimulation of the cell through MIMS and integrin receptors respectively, an inhomogeneous magnetic field of low frequency and high intensity is necessary. Therefore a special device with two specific permanent magnets fixed on a rotating electric motor was built. The applied strain was determined by physical laws and experimental calculations. The highest amount of an applicable force was measured with a specific magnetocytometer (Winoto-Morbach *et al.*, 1994) before and after mechanical stimulation of 2, 4 and 6 hours.
RESULTS: It was assumed that a labelled PDL fibroblast is subject to a magnetic force F, which is the magnetic moment of the MIMS multiplied by the factor of the gradient (dH/dx) of the magnetic field. The magnetic moment is proportional to the magnetization (M) of the magnetic particles incorporated in the MIMS multiplied by the intensity of the magnetic field (H). Therefore the magnetic force is $F = (Mm)\, dH/dx$, where m ($\sim d^3$) is the mass of the magnetic particles per one microsphere and d the diameter of the microsphere. The formula shows that the magnetic force is proportional to the diameter of the microsphere. In a system with MIMS of 1 µm in diameter and a magnetic field of 600 Oe the applied force on a cell is 1.2×10^{-4} dyne. With the distance of the permanent magnets to the cell layer it is possible to change the force and to calculate the exact amount.
CONCLUSIONS: A new *in vitro* system for specific mechanical stimulation of cells to answer clinical questions concerning tissue reaction during orthodontic tooth movement is introduced. The amount of strain used in this study is comparable to thta used by others (Wang *et al.*, 1993).

82 DENTOSKELETAL MORPHOLOGY OF CLASS II DIVISION 1 AND CLASS II DIVISION 2 MALOCCLUSIONS

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AIMS: To compare Class II division 1 and Class II division 2 malocclusions with respect to selected skeletal and dental variables.
SUBJECTS AND METHODS: Three hundred and forty-seven Class II division 1 and 156 Class II division 2 malocclusions, covering the age ranges 8–10 and 11–13 years, were analysed. A computerized evaluation of lateral cephalometric radiographs with respect to 23 variables was performed.
RESULTS: Irrespective of the ages of the subjects, a broad variation in dentoskeletal morphology existed in the two malocclusion samples. Although the frequency of different dentoskeletal traits varied, they were found in both samples: maxillary retrusion (13–23 per cent) and protrusion (4–13 per cent), mandibular retrusion (29–49 per cent) and protrusion (0–15 per cent); skeletal Class II (49–73 per cent) and Class III (1–3 per cent) jaw base relationships, high (5–13 per cent) and low (6–14 per cent) mandibular plane angles, retroclined (0–9 per cent) and proclined (7–54 per cent) lower incisors.
CONCLUSIONS: Except for the position of the upper incisors, no general difference in dentoskeletal morphology existed when comparing Class II division 1 and Class II division 2 malocclusions.

83 HISTOMORPHOMETRIC STUDY OF HUMAN CONDYLES

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AIMS: It has previously been shown, in a cross-sectional study, that the number of chondrocytes declines with age in TMJ condyles (Paulsen *et al.*, 1995). The aim of the present study was to quantify the fibrocartilage thickness, the trabecular bone volume BV/TV, and the structural parameter marrow space volume in a larger sample of autopsy TMJ condyles.
SUBJECTS AND METHODS: The material comprised 20 individuals, 16 men aged 18–30 years (21.8 ± 4.6) and 4 women aged 20–31 years (25.0 ± 5.0). From these, both condyles were obtained at death. One half condyle was embedded in plastic, cut on a Jung microtome (8 µm sections) and stained with Masson Trichrome. A computer connected to a microscope with a video camera attached was used to capture and store images of the sections. Average fibrocartilage thickness, BV/TV, and marrow space volume were obtained with a special program developed by one of the authors (JST).
RESULTS: Most individuals showed a large difference between left and right condyles in all parameters. In both males and females, an age-related decline in the thickness of the fibrocartilage was indicated. This might be explained by the previously described age-related decline in the cellular component (chondrocytes). No age-related changes were seen concerning trabecular bone mass or structure in these autopsy condyles.
CONCLUSIONS: Only slight age-related differences were found concerning the quantitative measurements for the fibrocartilage and the underlying bone tissue. However, further quantitative and qualitative investigations regarding the chondrocytes are needed in order to provide further information concerning growth potential at different ages.

Paulsen H U, Mosekilde Li, Hougen H P 1995 Autopsy study of human TMJ condyles in 18–24 year-olds. European Journal of Orthodontics 17: 450 (Abstract)

84 MANAGEMENT OF PALATALLY IMPACTED CANINES: A COMPARISON OF TWO TECHNIQUES

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AIMS: Many ectopic palatal canines require a combination of surgical and orthodontic management. Two types of approach are commonly used: simple exposure, and exposure with bonding at the time of surgery. The aim of this study was to determine the outcome and complication rate of each technique.
SUBJECTS AND METHODS: The case notes of 50 consecutively treated patients with palatally impacted canines were examined at two centres, one at which the ectopic tooth was surgically exposed, and the other at which an orthodontic bracket was bonded to facilitate early traction. The mean age of diagnosis was 13.9 and 14.5 years respectively, confirming the belief that presentation is often late.
RESULTS: The complication rate for those teeth exposed only and allowed to erupt into the palate before commencing traction was lower than those that were bonded. Of the exposed teeth, 11.5 per cent required a second surgical procedure, compared with 30.7 per cent of those bonded, due to either fractured ligature wire or bond failure.
CONCLUSIONS: Bonding is a more time-consuming and technique-sensitive method with a higher complication rate. It is recommended that exposure of palatal canines is an acceptable approach to treatment, producing an equivalent treatment time, and can be carried out effectively under day-stay anaesthesia with obvious ethical and financial benefits.

85 CARIES INCIDENCE AND *STREPTOCOCCUS MUTANS* OCCURRENCE IN ORTHODONTIC PATIENTS

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AIMS: Salivary *Streptococcus mutans* (Sm) level and its relationship with caries incidence in orthodontic patients with fixed appliances was investigated.
SUBJECTS AND METHODS: Thirty-three orthodontic patients (orthodontic group, OG), were compared with 42 control subjects (CG), before starting treatment with fixed appliances (t_0) and one year after (t_1). At t_0, the two groups were homogeneous: age (10.7 ± 1.4 years), male/female ratio (0.9), oral hygiene (plaque index: OG, 1.2 ± 0.6; CG, 1.1 ± 0.4, $P = 0.42$). Caries prevalence (DMFT index) was examined clinically and with bite-wing radiographs, at t_0 and t_1. Caries incidence (i.e. DMFT increment throughout the t_0–t_1 interval) was then evaluated. Salivary Sm was detected at t_0 and t_1, with a depressor pressed on the tongue and then on a plate containing a Sm-selective medium. Sm-positive subjects were those with at least one colony on the plate corresponding to a salivary Sm concentration of at least 104 colonies/mm of saliva. Statistically significant differences were evaluated using Student's *t*-test and the chi-squared test.
RESULTS: Caries incidence: OG, 0.4 ± 1.0; CG, 0.2 ± 0.7. OG caries incidence was higher than CG incidence, but the difference was not significant ($P = 0.28$) Sm occurrence (percentage of Sm-positive subjects): (i) t_0, 87.9 (OG), 85.7 (CG); (ii) t_1, 75.8 (OG), 95.2 (CG); (iii) t_0–t_1 changes: t_0 positive–t_1 negative: 21.2 (OG), 2.4 (CG); t_0 negative–t_1 positive: 9.1 (OG), 11.9 (CG). Differences between OG and

CG values concerning t_1 and t_0–t_1 changes were significant ($P = 0.03$ for t_1 values, $P = 0.03$ for t_0–t_1 changes).
CONCLUSIONS: Sm occurrence in orthodontic patients one year after the start of treatment was significantly lower than in control subjects. This may be explained by the oral hygiene motivation of these patients and by the use of glass–ionomer cements with their antibacterial activity. In spite of this, caries incidence in the OG was higher, although not significant, than in the CG, thus suggesting that caries risk in orthodontic patients is not related to salivary *Streptococcus mutans* levels.

86 ENAMEL CRACKS IN THE TEETH OF ORTHODONTICALLY TREATED AND UNTREATED PATIENTS

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AIMS: To assess enamel cracks on the buccal tooth surface of orthodontically treated (fixed appliances) and untreated persons.
MATERIALS AND METHODS: A total of 3681 teeth of 166 subjects (135 untreated and 31 treated), divided into four age groups (10–14, 15–19, 20–24 and 25–30 years of age) were examined *in vivo*. The number, direction, distribution and length of enamel cracks, diagnosed by using a punctiform source of light, were documented and statistically analysed (Kruskal–Wallis, Mann–Whitney *U*-test, Spearman's correlation coefficient).
RESULTS: No statistically significant differences between the orthodontically treated and untreated subjects were found with regard to the number and length of enamel cracks. The most frequently affected teeth in both groups were the first molars (with an average of 1.87 cracks per tooth) and the central incisors (with an average of 2.36 cracks per tooth). More than 90 per cent of the cracks were in a vertical direction. The horizontal and oblique ones were rare, except on teeth bonded with ceramic brackets. The numbers of cracks were independent of the treatment time with fixed appliances.
CONCLUSIONS: The results showed that enamel cracks are normal features in the human tooth surface and that orthodontic treatment has no negative influence unless ceramic brackets are used.

87 FINNISH ORTHODONTISTS' AND DENTISTS' VIEWS ON THE CHARACTERISTICS OF AN ACCEPTABLE OCCLUSION AT THE AGE OF 18 YEARS

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AIMS: To ascertain the views of Finnish orthodontists and dentists on the characteristics of an acceptable occlusion at the age of 18 years. The results will serve as guidelines for criteria on the outcome of orthodontic care in Finland.
SUBJECTS AND METHODS: In February 1995 a questionnaire was sent to all Finnish municipal health centres employing specialist orthodontists (37), to the corresponding number of health centres without a specialist orthodontist (31), to 12 consultant orthodontists, and to 13 orthodontists of university dental clinics. The respondents were asked to give their views on different characteristics of occlusion, and the relative significance of these characteristics. Morphological features were characterized by means of the criteria of the British IOTN and the Norwegian NOTI indices. The other characteristics—function, long-term stability and appearance—were asked about in the form of open questions. The response rate was 82 per cent.
RESULTS: Concerning morphological features, the IOTN definitions were accepted as such by 21 per cent and the NOTI by 25 per cent of respondents. Half the orthodontists and every fourth dentist preferred to add various morphological features not covered by these indices. The assessment of functional features was regarded as inevitable by 91 per cent of specialist orthodontists and 64 per cent of non-specialists. A larger number of orthodontists than dentists (62 versus 24 per cent) regarded long-term stability as very important. Half the respondents included the professional's view, and two-thirds of them the client's view of the dental and facial appearance, as a necessary part of the assessment.
CONCLUSIONS: The importance of the client's perception of his/her dental and facial appearance was supported by Finnish orthodontists and dentists. Moreover, in addition to morphological features, function and long-term stability were emphasized as important characteristics of an acceptable occlusion at the age of 18 years.

88 NEW MORPHOLOGICAL DATA ON THE HUMAN MIDPALATAL SUTURE

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AIMS: In order to obtain new information on the human midpalatal suture, biopsy samples from the anterior portion of the suture were surgically removed from 10 male and female patients between 10 and 30 years of age.
MATERIALS AND METHODS: The samples were fixed in glutaraldehyde, embedded in resin, cut with an ultramicrotome and analysed by light microscopy.
RESULTS: All the sutures exhibited a similar histological pattern. Connective tissue interposed between sutural bones was constituted by fibroblasts, collagen fibres, some capillaries and rare nerve fibres. Spindle cells with a mesenchymal aspect were observed along the bony margins, whereas osteoblasts or osteoclasts were never detected. Sutural bone was made up of lamellar and bundle bone which alternated along the sides of the connective tissue. Bundle bone, so-called for its resemblance to alveolar bundle bone, was largely crossed by Sharpey's fibres.
CONCLUSIONS: Whereas the function of the bundle bone

and Sharpey's fibres is clear, the functional meaning of the lamellar bone is equivocal. One possibility is that the lamellar bone substitutes the bundle bone when the suture is no longer involved in the growth and remodelling of the palatal bones. In this respect, lamellar bone could represent the structural basis for a possible process of synostosis. The absence of osteoblasts or osteoclasts along the bony margins lining the connective tissue suggests that the sutures are in a resting phase. Moreover, tissue architecture and cell types, which are very similar in all the sutures, leads to the belief that over a long period they are subject to a slow bone turnover.

89 ELECTRICAL MASSETER MUSCLE STIMULATION MAINTAINS CONDYLAR CARTILAGE IN ORGAN CULTURE

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AIMS: To examine whether, by electrically stimulating the masseter muscle, chondrogenic expression could be maintained under organ culture conditions in which the jaws with the craniomandibular joint were cultured in one block.
MATERIALS AND METHODS: Sixty BALB/c mice of both sexes were divided randomly into three groups of equal size. Two groups were decapitated at the age of 5 days and the cranial base and mandible were dissected out in one block and the explant was placed on its cut surface on a culture dish. The masseter muscles of the explants in one group were stimulated with an electric pulsing device delivering an AC current of a frequency of 0.7 Hz and an amplitude of 5 V with hourly active and silent periods. Five experimental and five control explants were fixed after culture periods of 1, 3, 7 and 14 days. The mice in the third group were used as *in vivo* controls.
RESULTS: By stimulating the masseter muscle electrically the deposition of type I and type II collagens and the thickness of the cartilage layers closely resembled the situation *in vivo*, while the controls in a non-functional environment gradually lost their characteristic form.
CONCLUSIONS: It is evident that the chondroblasts of the mandibular condyle lose their differentiated expression in long-term organ culture by altering their secretion of type I and type II collagens. By stimulating the masseter muscle electrically, the chondroblast phenotype normally seen *in vivo* can be maintained *in vitro*.

90 RECOVERY OF CRANIOFACIAL GROWTH AFTER A PERIOD OF UNILATERAL MASTICATORY FUNCTION

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AIMS: To reveal correctional changes in craniofacial growth when masticatory function is restored after a period of unilateral masticatory function.
MATERIALS AND METHODS: The maxillary and mandibular molars of 28 10-day-old anaesthetized rabbits were ground down to the gingiva on the right side twice weekly. Thirteen rabbits were left to grow to the age of 50 days and were killed at 100 days. In the remaining 15 animals the grinding procedure was transferred to the left side at age 40 days until they were 60 days old, after which they were allowed to grow and were killed at age 100 days. Sixteen unoperated rabbits served as controls. The skulls were freed of soft tissues. Dimensional measurements were made either directly from the skulls or from photographs. The inclination of the glenoid fossa was determined from a photograph after the zygomatic arch had been cut sagittally to reveal the fossa.
RESULTS: There were measurable dimensional differences in growth after the period of unilateral masticatory function as compared with the unoperated controls. The ramus in the mandibular halves was higher, the condylar process was larger sagittally and the angles between the inferior border of the mandible and the anterior and posterior borders of the condylar process were smaller. The differences were more pronounced on the left side. There were also marked dimensional differences between right and left sides in the maxillae. The inclination of the anterior part of the glenoid fossa was markedly steeper in both experimental groups, especially on the right side, and the posterior part was shallower in the group in which the molars had been ground down only on the right side.
CONCLUSIONS: Growth will not rectify all asymmetrical changes in the mandible, maxilla and glenoid fossa induced by a period of unilateral masticatory function.

91 A CEPHALOMETRIC ANALYSIS OF SRI LANKAN SUBJECTS WITH UNOPERATED ISOLATED CLEFT PALATE (ICP)

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AIMS: To address the debate as to whether mature unoperated ICP subjects have the ability for normal craniofacial growth, or whether they suffer from intrinsic deficiencies of the craniofacial complex which limit normal growth, and to describe precisely the craniofacial morphology of mature unoperated ICP subjects compared with mature non-cleft controls.
SUBJECTS AND METHODS: Lateral cephalograms were analysed using an optical and digital photographic technique. Nineteen reference points were located on the radiographs. From these landmarks, 18 angular and 16 linear dimensions were constructed. The absolute dimensions were compared statistically. All subjects analysed were Sri Lankan. The experimental group consisted of 18 mature subjects (9 females, 9 males) with unoperated ICP. The control group consisted of 62 mature non-cleft subjects (31 females, 31 males). Males and females were analysed separately.

RESULTS: Mature unoperated ICP subjects do differ from mature control subjects in facial morphology, but not in cranial base morphology. Mature unoperated ICP subjects can be described as having a characteristic facial form consisting essentially of bimaxillary retrusion with bimaxillary retroclination, high maxillary/mandibular plane angles and a normal relative maxillary/mandibular jaw relationship. The maxilla is intrinsically deficient vertically and antero-posteriorly, and the mandible displays a particular form: a short ramus height, a short body and a reduced total length and an increased gonial angle. This is coupled with an increased lower anterior face height. However, the cranial base is normal. Mature male and female unoperated ICP subjects follow essentially the same facial form, although females are smaller than males for natural and cultural reasons.
CONCLUSIONS: Mature unoperated ICP subjects do have intrinsic deficiencies of the face (mainly of the maxilla and mandible), but not of the cranial base. These differences are evident in both sexes. The precise craniofacial morphology of mature unoperated ICP subjects has been summarized.

92 APOPTOSIS DURING THE DEVELOPMENT OF MOUSE CRANIAL SUTURES

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AIMS: To analyse the possible role of apoptosis (programmed cell death) in cranial suture development, by the localization of apoptotic cells both temporally and spatially in mouse calvaria.
MATERIALS AND METHODS: Whole mount and sectioned tissue of mouse cranial sutures aged between the 14th embryonic day (E14) and 4th postnatal day were studied. Apoptosis was detected by TdT-mediated dUTP-biotin nick-end labelling (TUNEL), and sections counterstained with van Gieson stain.
RESULTS: Apoptosis was observed in (i) the mid-sutural area of sagittal and lambdoidal suture from E16 to E18 only, these cells appeared to be mesenchymal cells; and (ii) the frontal, parietal and interparietal bones in increasing numbers from E17 onwards notably on the endocranial surfaces. These cells appeared to be osteoclasts and this was supported by the detection of tartrate-resistant acid phosphatase activity (TRAP). Large apoptotic cells were occasionally seen at the tip of osteogenic fronts.
CONCLUSIONS: (i) As advancing osteogenic fronts come into close proximity, intervening mesenchymal cells appear to undergo apoptosis. At this stage the suture takes on a specific morphology, namely the blastema. Apoptosis may therefore play a role in suture morphogenesis and maintenance. (ii) Osteoclasts appear to undergo apoptosis in calvarial bones, and this may be an important feature in the regulation of osteoclastic function in bone remodelling.

93 A NON-INVASIVE METHOD OF ASSESSING INCISOR INCLINATION

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AIMS: To compare upper and lower incisor inclinations as determined using radiographic techniques with a new, simple and quick non-invasive Tooth Inclination Protractor (TIP).
METHODS: A sample of 47 lateral cephalograms and corresponding dental casts were assessed (12 Class I; 13 Class II division 1; 10 Class II division 2; 10 Class III; and 2 open bite cases). Upper and lower incisor angulations were measured to the respective maxillary and mandibular planes as well as the occlusal plane. The upper and lower left and right incisors on the dental casts were recorded to the respective occlusal planes using the TIP. The reliability and validity of both methods was determined.
RESULTS: The TIP scores were found to be more reliable than the radiographic scores for intra- and inter-examiner assessments. The upper incisor inclination, as determined by the TIP, on average underscored by 10.5 degrees compared with radiographic assessments of upper incisors to palatal plane. The TIP tended to consistently underscore by 2 degrees for lower incisor to mandibular plane.
CONCLUSIONS: The TIP was more reliable than the lateral skull radiograph in assessing both maxillary and mandibular incisor inclinations, and appears to be a valid measure of incisor inclination.

94 INTEGRIN EXPRESSION AND CYTOKINE MODULATION IN PERIODONTAL LIGAMENT FIBROBLASTS

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AIMS: To characterize (i) the expression of β1 integrins in fibroblasts isolated from human periodontal ligament (PDL) and from dermal fibroblast; (ii) the changes of β1 integrin expression in these cells induced by inflammatory molecules and cytokines; (iii) the effect of various extracellular matrix proteins on PDL fibroblast proliferation.
MATERIALS AND METHODS: Monodispersed cell suspensions obtained from PDL or dermal specimens were plated on Petri dishes and cultured *in vitro*. The presence of contaminating epithelial cells in the culture was excluded by a specific anti-cytokeratin antibody. The expression of α and β subunits of VLA on the cell membrane was measured by specific monoclonal antibodies using the flowcytometric technique.
RESULTS: In fibroblasts from PDL, as in dermal fibroblasts, all integrin subunits of the β1 family were expressed at variable levels. In dermal fibroblasts the expression of α1, α2, α3 and α4 was higher than in PDL cells. The expression of these molecules was measured in fibroblasts after *in vitro* stimulation by cytokines. Adhesion to the extracellular matrix proteins was also determined, and showed a stronger

cell adhesion to fibronectin and collagen than lamina. [^{3}H]Thymidine assay was measured in stimulated fibroblasts.
CONCLUSIONS: Both cell types, interleukin-2 and interferon-γ, determine a modulation of β1 integrin expression inducing different profiles between PDL and dermal fibroblasts. No induction of [^{3}H]thymidine incorporation was observed in the presence of fibronectin and type I collagen in fibroblasts of PDL origin.

95 THE CHANGES FOLLOWING ORTHOGNATHIC SURGERY: AN ASSESSMENT OF THREE OCCLUSAL INDICES.

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AIMS: To investigate the changes that occur during and after orthognathic treatment, and to assess the ability of three occlusal indices to detect these changes.
SUBJECTS AND METHODS: The sample consisted of 37 patients who had undergone orthognathic treatment at one hospital. Lateral skull radiographs and study models were taken before treatment, at the end of treatment and several months after the end of retention (mean time out of retention 17 months). The radiographs were analysed by measuring seven angles and four distances. The study models were assessed using the Peer Assessment Rating (PAR) Index, Grainger's Treatment Priority Index (TPI) and Summers' Occlusal Index (OI).
RESULTS: Cephalometric analysis of the radiographs indicated that correction of the Class II malocclusions was achieved largely by a combination of mandibular advancement (SNB increase 2.57 ± 2.54 degrees) and retroclination of the upper incisors (–8.57 ± 10.17 degrees). The mean pre-treatment SNA angle was within the normal range (82.47 ± 4.52 degrees) and this was not significantly altered during treatment. When occlusal indices were applied, the scores were substantially improved during treatment and the improvement was largely maintained afterwards. Correction of Class III malocclusions was achieved by a combination of maxillary advancement (mean SNA increase of 2.15 ± 2.4 degrees) and mandibular setback (mean SNB decrease of –3.31 ± 1.91 degrees). At least 25 per cent of the maxillary advancement (SNA) relapsed after treatment, but simultaneous relapse of the lower incisor proclination limited the effect on the overjet. Nevertheless, the mean overjet relapsed by 1 mm after treatment. When applied to the Class III cases the scores were substantially improved during treatment and altered only slightly after treatment for the PAR Index and TPI. A significant increase in the scores occurred after treatment when Summers' OI was applied, indicating that relapse had occurred. Of the three occlusal indices used, only Summers' OI was able to detect the changes which cephalometric analysis showed occurred after treatment in the Class III cases. While Summers' OI appears to have been more sensitive than either PAR or TPI, problems were encountered as it failed to reflect adequately the severity of malocclusions where skeletal asymmetries existed.
CONCLUSIONS: The results of this study suggest that occlusal indices may not be suitable for detecting relapse after orthognathic treatment, and they should not be used as the sole indicator of stability.

96 EARLY DECISION FOR ORTHOGNATHIC SURGERY IN UNILATERAL CLP PATIENTS

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AIMS: Unfavourable facial growth in patients with cleft lip, alveolus and palate may occur during the pubertal growth spurt. Usually this development is not evident at a young age. The aim of the present study was to find a procedure to predict for an individual at an early age whether orthognathic surgery should eventually be included in the treatment plan.
SUBJECTS AND METHODS: The patients investigated were all treated by the same concept. The cephalograms of 41 UCLP patients with observation intervals of 4 years were computerized, correlations between the variables of the first and second radiographs were calculated, and regression equations were established.
RESULTS: The skeletal change of the intermaxillary relationship can be explained by the lack of midface growth only. The individual prediction over an interval of 4 years for the SNA angle can be given with a correlation coefficient of 0.95. Additional predictions for SNB angle, Holdaway angle and index of anterior facial height proportions are demonstrated.
CONCLUSIONS: The given prediction procedure facilitates the decision at the age of 12, as to whether orthodontic occlusal treatment may be completed at an early age. The alternative is to limit orthodontic treatment to form two dental arches independent of the intermaxillary relationship and correct the facial skeleton and the dental occlusion at the same time by combined orthodontic–orthognathic treatment after completion of growth.

97 SELECTIVE ACTIVATION OF MUSCLE AND FUNCTIONAL ASPECTS

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AIMS: Muscular activation processes during different functional motor tasks have mainly been described by temporal parameters of muscle recruitment. However, on the basis of previous morphological (e.g. structural parts of masseter muscle and their innervation: Schumacher, 1961; Kurzmann, 1991) and physiological results (selective control of the motor units of masseter muscle: Stalberg and

Eriksson, 1987), it can be assumed that a spatial aspect of muscle activation also exists. Thus, this study aimed to create a non-invasive electrophysiological technique which can characterize the topography of muscle activation during different functional conditions and to find arguments for a selective activation of muscle compartments.
METHODS: By means of a monopolar 16-channel surface electromyographic (EMG) technique, muscles with several structural parts (masseter, biceps brachii, thenar, quadriceps femoris) of 55 healthy subjects and 20 patients with motor dysfunctions of central origin were investigated during defined load conditions. On the skin above the muscles, the 16 electrodes were distributed with respect to the morphological and functional conditions of analysed areas. EMG samples without artefacts were used to calculate spectral EMG parameters via fast Fourier transformation (FFT). Afterwards, the spectral EMG parameters between the 16 electrode positions were then estimated by linear interpolation (four-nearest-neighbours algorithm). The obtained matrix of spectral parameters provides an estimate of the two-dimensional distribution of myoelectrical activation (spectral EMG mapping).
RESULTS: Depending on the characteristics of the performed motor tasks, the direction of acting torques, the torque amplitudes, etc., the EMG maps of analysed muscle were structured in a specific and reproducible manner. Furthermore, the characteristics of the activation pattern were correlated to the functional situation of the investigated muscles. There were distinct differences of the activation pattern between masseter as well as thenar muscle and the biceps brachii muscle. In patients with motor functions of central original (e.g. stroke patients), the EMG maps were changed in comparison with the controls (partly significant differences).
CONCLUSIONS: The results of this study support the previous findings assumed for a selective activation of muscle compartments.

98 TOPOGRAPHY OF SPECTRAL EMG CHARACTERISTICS OF TEMPORALIS AND MASSETER MUSCLES DURING MANDIBULAR MOVEMENTS

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AIMS: Results of previous studies indicate that topographically different EMG distributions have to be expected within the chewing muscle. To demonstrate the localization of the main activated muscle areas with respect to the moving direction of the mandible, the temporal and masseter muscles were investigated during defined isometric conditions by spectral EMG mapping.
METHODS: In 44 healthy volunteers, 16-channel surface monopolar EMGs were recorded from the temporal and the masseter muscles (reference: contralateral ear lobe) during constant biting on a left and then right placed force transducer and during constant frontal as well as lateral force application to the mandible, which had to be compensated by the subjects. After power spectral analysis of artefact-free EMG intervals, spectral characteristics (15.6–496 Hz) were evaluated with regard to the time course and the muscle topography.
RESULTS: The spectral EMG power differed significantly between the 16 electrode positions. In the temporal muscle during biting, the highest EMG activity was localized in the anterior part. When the mandible was loaded from the ipsi- and contralateral side as well as pulled from a frontal position, the maximum EMG activity was found in the middle and posterior parts of the temporal muscle. When the mandible was pressed from a frontal position, the localization of the maximum EMG differed interindividually between the anterior and posterior muscle regions. In the masseter muscle during biting and following loading from the frontal and contralateral positions, maximum EMG amplitude power was found in the lower third, but in the upper posterior region during loading from the ipsilateral side. Statistical differences were found between the EMG levels and the topographic EMG distributions if the load direction or the force was changed.
CONCLUSIONS: These results permit the conclusion that there are separate motor regions which are activated in a differential way depending on the actual functional requirement. Such activation patterns are probably influenced by the changes of the morpho-functional conditions of the orofacial region.

99 AN ORTHODONTIC STUDY OF TEMPOROMANDIBULAR DEGENERATIVE JOINT DISEASE

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AIMS: The cause and related elements of degenerative joint disease (DJD) are rarely reported because of its ambiguous nature. After DJD, patients were reviewed at the Department of Orthodontics, Tokyo Dental College, Suidoubashi Hospital, and the following observations were found based on maxillofacial features and occlusions.
SUBJECTS AND METHODS: Patients suspected of having DJD according to temporomandibular tomography were examined. The patients (six females, one male, ages 14–29; average age 21 years 2 months) had a reduced ratio in the vertical dimension from the mandibular plane to the condylion and coronoid process discovered by examination with a lateral cephalogram. General examinations, interviews, inspection and palpation, cephalometric analyses, study model analyses and CPI checks were carrried out.
RESULTS: (i) Those patients who had experienced TMD symptoms 3–15 years previously still showed crepitus by

palpation; however, most of them did not exhibit pain or dysfunction. (ii) Cephalometric analysis revealed a reduced ramus and mandibular body height. Almost all showed a dolichofacial pattern (average 2.2 SD). (iii) Oral examination showed both an anterior and posterior open bite with an unstable mandibular position and inferiorly shifted condyle in the intercuspal position by CPI.
CONCLUSIONS: The loss of appropriate guidance from the severe clockwise rotation of the mandible might cause TMD by exceeding the burden toward the TMJ. This could change the joint anatomy so that the height of the ramus is thereby reduced, aggravating the skeletal open bite. It can be inferred that the existence of the long-term circulation is one of the causal factors of DJD.

100 CARTILAGE PRODUCTION *IN VITRO*

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AIMS: The *in vitro* environmental conditions for optimal cartilage production were investigated and the correlation between these conditions, the intracellular calcium ion concentration $[Ca^{2+}]_i$ in chondrocytes, and glycosaminoglycan production was determined.
MATERIALS AND METHODS: Limb bud mesenchymal cells were isolated from stage 24 chick embryos and seeded into multi-well plates. Cultures were fed with control medium (αMEM + 5 per cent fetal calf serum), or control media containing 0.5 mM dibutyryladenosine 3′:5′-cyclic monophosphate (cAMP), 5 mM nicotinamide or 6 mM benzamide. After 6 days in culture, experimental and control cultures were fixed and stained with alcian blue for quantification of matrix production by image analysis. For investigation of $[Ca^{2+}]_i$, chondrocytes were loaded with the calcium-specific fluorescent dye, Fura-2/AM (1 μm) for 20 minutes at 37°C and the mediators added. Fluorescent images at 340 and 380 nm were recorded and $[Ca^{2+}]_i$ was calculated from the ratio of the dyes' fluorescent intensities. To determine the presence of chondroitin sulphate in control and experimental cultures, an enzyme-linked immunoabsorbent assay was performed and the colour reaction quantitated by absorbency spectrophotometry at 620 nm.
RESULTS: Cartilage matrix production and chondroitin sulphate were significantly stimulated with 0.5 mM cAMP and 5 mM nicotinamide, and were inhibited by 6 mM benzamide. $[Ca^{2+}]_i$ increased to 300 nM immediately following the addition of cAMP and nicotinamide and then decreased to resting levels over 5 minutes. Benzamide increased the $[Ca^{2+}]_i$ in some cells and decreased it in others.
CONCLUSIONS: The production of chondroitin sulphate in chondrocytic micromass cultures can be stimulated *in vitro* and this is associated with an overall increase in cartilage matrix production. An increase in $[Ca^{2+}]_i$ may be one of the cellular signals necessary for the production of glycosaminglycans from chondrocytes.

101 SHEAR BOND STRENGTHS OF BRACKETS BONDED WITH LIGHT-CURED GLASS IONOMERS

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AIMS: Shear bond strengths of different light-cured glass ionomer cements were evaluated to determine if these materials (which need no enamel etching with phosphoric acid) are suitable for clinical use as bracket adhesives.
MATERIALS AND METHODS: The evaluated adhesives were (1) Dyract ortho (DeTrey/Dentsply), (2) Photac Bond (Espe), (3) Iocomp A 20 (DMG), (4) Fuji Ortho (GC). Concise (3M) was used as the control group adhesive. The brackets were stainless steel mesh-backed lingual buttons (Dentaurum) with 12.25 ± 0.1 mm^2 bracket base area. Fifty bovine incisors were trimmed with silicone carbide discs (Struers, Copenhagen) to achieve planar surfaces. The equilibrated labial surfaces were polished with fluoride-free prophylaxis paste (Oral B), rinsed with water, and subsequently dried. For further treatment the enamel surfaces in the control group (n = 10) were etched with 37 per cent phosphoric acid for 30 seconds, while in groups 1–4 (each n = 10) they were treated with 10 per cent polyacrylic acid for 10 seconds. All specimens were rinsed for 30 seconds and dried. The brackets were bonded by polymerizing the adhesives with visible light (Heliomat, Vivadent). Specimens were stored for 24 hours in water at 23°C. The shear bond strength was determined according to ISO specification TC 106/SC2/WG16 with a universal testing machine (Erichsen 464 LE4SOON). Bond strength values were compared with Student's t-test.
RESULTS:

	Adhesive				
	Dyract	Iocomp	Photac	Fuji Ortho	Concise
Shear strength (MPa)	10.55	13.99	23.90	28.17	33.49
SD (MPa)	3.64	2.84	2.77	3.05	7.05

CONCLUSIONS: Fuji Ortho and Photac Bond show sufficient shear bond strengths to commend them for clinical use. With the use of these adhesives, there is no need for enamel etching with phosphoric acid and it can be expected that there will be less initial damage to the enamel and easier debonding because of minimal remnant adhesive.

102 THE SUITABILITY OF NOTI AND IOTN IN THE EVALUATION OF AN ACCEPTABLE OCCLUSION AT THE AGE OF 18 YEARS

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AIMS: To ascertain the opinions of Finnish orthodontists and dentists about the suitability of the definitions of the Need of Orthodontic Treatment Index (NOTI) and the Index of Orthodontic Treatment Need (IOTN) in the evaluation of an acceptable occlusion at the age of 18 years.
SUBJECTS AND METHODS: In February 1995 a semi-structured questionnaire was sent to all health centres where at least one orthodontist was employed (37), to health centres without an orthodontist (31), to 12 consultant orthodontists and to 13 orthodontists working at university dental clinics. The demarcation line between moderate and little orthodontic treatment need in NOTI and IOTN was used to describe the characteristics of occlusal health. The questionnaire was returned by 76 subjects (82 per cent).
RESULTS: The definitions of both indices were accepted as such by five orthodontists and seven dentists (16 per cent of the respondents). Eight orthodontists and 11 non-orthodontists (25 per cent) agreed with the criteria in NOTI and seven specialists in orthodontics and nine non-specialists (21 per cent) agreed with those in IOTN. The main reasons for the rejection of these criteria were as follows. Horizontal measurements were regarded as too coarse, because they did not reveal anything about the skeletal relationship of the jaws. Vertical and transversal definitions were rejected on a functional basis. Concerning crowding, spacing and median diastema, the respondents liked to pay attention to the clients' opinion. The answers were statistically significantly associated with the respondents' dental education level and working place.
CONCLUSIONS: Finnish orthodontists and dentists seem to pay more attention to functional aspects of occlusion than do the NOTI and IOTN definitions. The concepts of reverse overjet, crossbite with slide and open bites have to be further formulated, in order to apply them in evaluating the acceptable occlusion of an 18-year-old adolescent.

103 THE FUNCTIONAL OROPHARYNX AND ITS FACIAL RELATIONSHIPS

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AIMS: To find a relationship between the functional oropharyngeal airway (minimal separation of tongue from the posterior pharyngeal wall) and the dentofacial structures.
SUBJECTS AND METHODS: A cohort of 154 patients was divided into two groups: (1) 96 where Downs' point B was behind point A (Class I and II) and (2) 58 where point B was in front of A (Class III). The radiographs were drawn consecutively from the files of the Royal Preston Hospital Orthodontic Department. The age range was 6–20 years; all subjects were Caucasian. Patients with cleft palates and facial syndromes were excluded. Conventional hard tissue reference points were marked on the tracings to provide six angular and 10 linear measurements. These were statistically correlated with the oropharyngeal dimension. Ten per cent were retraced and remeasured to check for errors. All were within 2–7 per cent of the biological variation in the parameters measured.
RESULTS: Significant correlations were found in Group 1: oropharynx to (i) NSBa $r = 0.36$ ($P < 0.001$) (ii) ANB $r = -0.46$ ($P < 0.001$), (iii) Go–Me $r = 0.35$ ($P < 0.001$), (iv) Hy–C3 $r = 0.31$ ($P < 0.01$). In Group 2: oropharynx to (i) Go–Me $r = 0.28$ ($P < 0.05$), (ii) Hy–C3 $r = 0.54$ ($P < 0.001$). Comparing group 1 with group 2, the mean distance Ba–Downs' point A was 3.4 mm shorter in group 2.
CONCLUSIONS: The size of the functional oropharynx is related to the length of the mandible (Go–Me) and its position to the maxilla (ANB), and also the position of the hyoid bone from the third cervical vertebra (Hy–C3), but not its distance from the mandible.

104 COMPARISON OF CEPHALOMETRIC ANALYSIS USING A SONIC DIGITIZER WITH CONVENTIONAL RADIOGRAPHY

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AIMS: To compare the validity and reproducibility of cephalometric measurements using the DigiGraph Workstation (Dolphin™ Imaging Systems) with conventional radiographic tracings of human dry skulls.
MATERIALS AND METHODS: The sample comprised 30 human dry skulls. From a total of 15 cephalometric landmarks (all except four made radiographically visible with steel ball markers), 15 angular and one linear cephalometric measurement were recorded. Lateral cephalograms were taken of each dry skull. After repositioning the steel ball markers, and the skulls, further sets of radiographs were taken. Double digitizations were then made on each radiograph with the Dentofacial Planner™. For the DigiGraph Workstation, the skulls were each digitized twice with the sonic digitizer. After repositioning the skulls, sonic digitizations were again repeated twice. ANOVA and paired *t*-test were used on these eight series of measurements. Radiographic tracings were taken as the 'gold standard'.
RESULTS: Ten of the 16 cephalometric measurements showed significant differences between the two methods. The DigiGraph Workstation consistently produced higher values in seven measurements and lower values in three measurements. The DigiGraph Workstation showed a lower reproducibility. The reproducibility of all measurements ranged from ±0.77 to ±6.15 for the DigiGraph Workstation and from ±0.15 to ±0.69 for the radiographic tracings.
CONCLUSIONS: Systematic error was found for 60 per cent of the measurements obtained with the DigiGraph Work-

station. The reproducibility of cephalometric measurements was lower with the DigiGraph Workstation than with conventional radiographic tracings.

105 EFFECTS OF DIFFERENT VECTORS OF FORCE APPLIED BY COMBINED HEADGEAR ON SKELETAL AND DENTOALVEOLAR STRUCTURES

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AIMS: To evaluate the effects of different vectors of force applied, using combined headgear, for upper molar distalization in the treatment of Class II malocclusions on the skeletal and dentoalveolar structures.
SUBJECTS AND METHODS: Thirty patients with a Class II dental relationship and steep mandibular plane angle. Lateral cephalograms, posteroanterior, basilar and hand-wrist radiographs were taken before and after treatment. All of the patients were treated with extraoral combined traction to the maxillary first molars. In the first treatment group a force of 150 g per side was adjusted for the high-pull component, and 150 g per side for the cervical component. In the second treatment group force adjustment was made as 200 g per side for the high-pull component, and 100 g per side for the cervical component, and in the third treatment group a force of 100 g per side was adjusted for the high-pull component, and 200 g per side for the cervical component. The patients were instructed to wear the appliance until the molar relationship was corrected. The parameters obtained from the radiographs were evaluated by statistical analysis.
RESULTS: Molar distalization was achieved by different vectors of forces applied by combined headgear. Changes in the direction of pull were effective on upper first molar tipping degree and vertical displacement. Furthermore by the evaluation of occlusal and mandibular plane angles, significant differences between the groups were observed.
CONCLUSIONS: For individuals showing vertical growth tendencies, occipitally directed forces applied by combined headgear were more convenient compared with other types of force systems used in this study .

106 RELIABILITY AND REPRODUCIBILITY OF THE LANDMARKS OF POSTERO-ANTERIOR CEPHALOMETRY

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AIMS: To evaluate the reliability and reproducibility of the most commonly described and used landmarks that can be identified on a postero-anterior cephalogram.
MATERIALS AND METHODS: The material consisted of 30 postero-anterior cephalograms taken in the natural head position in a standardized way which were presented to five examiners who were asked to identify 34 landmarks on each of the radiographs. All landmarks were transferred to a computer program with the use of a digitizing table equipped with a calibrated x–y co-ordinate system. In this way every landmark was related to the co-ordinate and characterized by an x- and a y-co-ordinate. Each landmark on every cephalogram was indicated by five points that corresponded to the localization by the five different examiners. In order to match the same landmarks of different cephalograms, an arithmetical centrepoint was constructed. To be able to judge the accuracy of the digitizing procedure, one randomly selected tracing was digitized 10 times.
RESULTS: The digitizing error was negligible compared with the errors introduced by landmark identification on postero-anterior cephalograms. The six most accurate landmarks were right mastoid, left latero-orbitale, left mastoid, right latero-orbitale, left antegonion and right antegonion. The six least accurate landmarks were left coronoid, right condylar, left condylar, left mandibular foramen, right mandibular foramen and right coronoid.
CONCLUSIONS: Each landmark had its own characteristic envelope, and the same landmarks, bilaterally, exhibited very similar envelopes. A significant difference in the accuracy of landmark identification was found between the subsequent landmarks, and for most landmarks a difference in the accuracy between x- and y-directions was present.

107 CEPHALOMETRIC SUPER-IMPOSITIONING ON THE FORAMEN MAGNUM

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INTRODUCTION AND AIMS: Superimpositioning on an area around the foramen magnum is not a common procedure for the analysis of lateral cephalograms. Coben (1955) and Fränkel (1980) are the only authors who describe some type of a superimposition on the occipital and clivus area. The tracing and superimpositioning technique used in this investigation utilizes the form of the clivus with basion, and the projection point articulare in combination with opisthion. The image of the internal occipital crest may be helpful for more accurate superimpositioning. The distance articulare–basion remains nearly constant after the age of 7 years. This study will show the mean and extreme displacement patterns of the sella–nasion line, the palatal line (posterior–anterior nasal spine), mandibular line (gonion–gnathion) and points A and B, after superimpositioning on the foramen magnum.
MATERIALS AND METHODS: Cephalograms of the longitudinal Groningen Elementary School Study. The age range was between 6 and 32 years, yielding 2–14 photographs per individual. None of the 181 children had received orthodontic treatment. All 1237 cephalograms were traced and 47 landmarks were localized, digitized and checked for errors. Only 11 landmarks were used in this study. A group of 56 individuals, who had a cephalogram in both the 9- and

the 16-year age group, was selected from the original study. A mathematical routine fits the first set of the three digitized landmarks—articulare, basion and opisthion—representing the 9-year cephalogram for a single individual, on the 16-year set by the least-squares method. A vector for each of the eight landmarks can be calculated in the common x–y co-ordinate system. The x-axis is drawn through the mean basion and opisthion (foramen magnum) landmarks. The point basion is chosen as the origin.

RESULTS: The extreme and mean displacements of the eight mentioned landmarks are shown graphically and in the form of a table for the male and female group. Some very extreme patterns of displacement are visible in this material. There is a wide variation in the displacement of each individual landmark, but a general pattern is discernible. The sella–nasion line moves upwards and forwards during this 7-year interval, the palatal line stays approximately in the same vertical position and the mandibular line (gonion–gnathion) shows a counterclockwise rotation.

CONCLUSIONS: Superimpositioning on the foramen magnum shows a distinct difference in comparison with sella–nasion superimpositioning. Furthermore the displacement of points A and B is no longer connected with the change in the position of nasion.

108 CHEWING PATTERN ANALYSIS IN YOUNG DYSGNATHIC PATIENTS

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AIMS: To investigate the changes in mandibular movements whilst chewing a piece of gum in young subjects with a Class II division 1 malocclusion at different stages in the development of the dentition, and with regard to overbite and overjet.

SUBJECTS AND METHODS: Twenty-two subjects at the Department of Orthodontics, University of Catania, with a mean age of 13.3 years, and without signs and/or symptoms of TMJD or crossbite, were used in the study. The patient pool was divided into three subgroups: (a) 11 subjects in the mixed and 11 in the permanent dentition; (b) 16 subjects with an overbite of 5 mm and 6 with an overbite greater than 5 mm; (c) 16 subjects with an overjet up to 5 mm and 6 with an overjet greater than 5 mm. The mandibular movements during chewing were recorded using the Biopak system (Bioresearch Inc.). Five chewing strokes, from the third to the seventh stroke after the initiation of chewing, were selected for analysis. The recordings were repeated three times in different recording sessions. The measured parameters were the mean values and standard deviations for the lateral, vertical and antero-posterior distance between the intercuspal position and the point of transition from opening to closing, and for the maximum and lateral width of the envelope of motion. The morphological criteria for classification of chewing pattern were those proposed by Kuwahra. The mean values of the groups were compared by t-test and Mann–Whitney U-test.

RESULTS AND CONCLUSIONS: The results obtained did not show any statistically significant differences among the various subgroups. This could mean that the parameters examined do not influence chewing patterns.

109 TREATMENT EFFECT OF THE FUNCTIONAL HANSA APPLIANCE IN CLASS II MALOCCLUSIONS

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AIMS: To analyse the changes during treatment with the Hansa functional appliance.

MATERIALS AND METHODS: From a group of 92 patients treated with the Hansa functional appliance by the same orthodontist at the orthodontic department at Hamburg University, the cephalometric measurements at the beginning and end of functional appliance treatment were analysed. The radiographs were measured using a digitizer coupled to a computer using double registration. Statistical analyses were performed using the SPSS software package.

RESULTS: The results of the comparison of the pre- and post-treatment records showed the main changes to occur in the dental variables and in the soft tissue profile. A multiple regression analysis showed highly significant correlations for the dependent variables, ANB change during treatment and ANB angle after treatment. The changes were compared with untreated Class II patients to eliminate the effects of natural growth.

CONCLUSIONS: The soft tissue profile was straightened by the treatment, and while the occlusion and hard tissue profile was normalized, the lips became less protrusive.

110 THE NEED FOR ORTHODONTIC PREVENTION IN THE LIGHT OF CAUSES OF MALOCCLUSION

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AIMS: Between 55 and 85 per cent of malocclusions are, according to Polish dental literature, caused by deleterious oral habits, the most common of which are thumb-, finger-, dummy- and lip-sucking. The variety of malocclusions caused by these habits include anterior open bite and disto-occlusion crossbite. The objective of this investigation was to examine the connection between a deleterious sucking habit and the necessity for prevention, which includes cessation of the habit and early treatment.

SUBJECTS AND METHODS: Forty-six children aged 3–5 years with deleterious sucking habits were examined, observed and treated. Removable and functional appliances were used during treatment.

RESULTS: Positive results were obtained in 30 per cent of cases treated. Treatment depended on a combination of child, parents and orthodontist working together. Removable/

functional appliances were worn by the children for an average treatment time of 2 years.
CONCLUSIONS: Orthodontic intervention is indicated in patients with sucking habits to prevent severe deformation of dental arches and permit early correction of shape to allow the normal development of occlusion. The correction of a deleterious sucking habit and early treatment offers the opportunity to minimize the severity of a malocclusion. The success of treatment depends on good co-operation between orthodontist, child and parents.

111 IMAGE ANALYSIS OF ENAMEL DEMINERALIZATION ASSOCIATED WITH FIXED ORTHODONTIC APPLIANCES

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INTRODUCTION: White enamel spots and demineralization can occur during orthodontic treatment which may or may not remineralize later. In a study of 52 patients treated in Sheffield, 9.8 per cent of tooth surfaces showed some evidence of white spots and demineralization, mostly of a minor nature.
METHODS: Photographic images of such demineralization which occurred in relation to pre-adjusted edgewise brackets were captured by a frame grabber, and image analysis was carried out with appropriate software (Optimeric, Bioscan Ltd). Various image-processing techniques, including the use of filter templates, morphological operations and edge detection, were used to identify the extent of the demineralization.
RESULTS: The resulting pictures graphically demonstrate the problem. Measurements of light intensity, using line morphometry, histograms and three-dimensional luminance plotting, enabled the extent and severity of the problem to be studied quantitatively. The results are being correlated with *in vitro* studies. A variation of grey level intensity of 10–20 per cent [typically from grey level intensity of 145–170 on a scale of 0 (black) to 255 (white)] is seen in demineralized areas. Photographs taken and analysed some months after debonding show a reduction in these grey level differences where remineralization has occurred.
CONCLUSIONS: Enamel demineralization and white spot lesions occurring during and after fixed appliance orthodontic therapy can be visualized and studied objectively by computerized image analysis.

112 CONFOCAL LASER SCANNING MICROSCOPY OF ACID-ETCHED ENAMEL

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AIMS: The aims of this study were to assess, by means of confocal laser scanning microscopy (CLSM), structural changes occurring in enamel under surfaces subjected to acid etch treatment and subsequently exposed to the oral environment *in vivo*, as well as to measure the penetration depth of phosphoric acid into enamel during etching.
MATERIALS AND METHODS: Enamel blocks (5 × 5 × 3 mm) were prepared from extracted premolars. One surface of each block was etched for 60 seconds with 37 per cent orthophosphoric acid, rinsed for 20 seconds with water and air-dried, whilst other enamel surfaces were covered by inlay wax. Subsequently six enamel samples were attached to molars of volunteer subjects using glass–ionomer cement and left *in situ* for 3 weeks. After recovery, qualitative structural changes in experimental samples and the corresponding controls were examined under CLSM. In the study of acid penetration depth, additional samples were prepared, etched and assessed under CLSM using reflection mode or treated with a fluorescein-labelled pH-sensitive probe and evaluated using CLSM fluorescence mode.
RESULTS: Substantial structural changes associated with acid application were observed to occur at a depth of 100 µm below the etched surface, which largely remained after exposure to the oral environment. After etching and rinsing of enamel, pH-label penetrated 50 µm and deeper below the surface. On the etched surface enamel prism appearance—reminiscent of etch patterns described for electron microscopy—was detected. After exposure to an oral environment a 10–15 µm wide hyper-reflexible band developed immediately below the etched surface, indicating deposition of salivary material.
CONCLUSIONS: CLSM is a simple, reliable and highly reproducible method of qualitative assessment of structural changes in enamel associated with acid etch technique and remineralization treatment. In addition to superficial substance removal, phosphoric acid application causes marked structural alterations in subsurface enamel layers, reaching 100 µm and more in depth. Residual acidity may remain in subsurface enamel after the conventional acid etch treatment. Remineralization appears to be limited to 10–15 µm deep superficial enamel layer.