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EUROPEAN ORTHODONTIC SOCIETY
80th Congress Aarhus, Denmark 2004
7-11 June

1 UNILATERAL HEADGEAR: FACT OR FICTION?

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AIM: To select the most effective point of force application to achieve asymmetric delivery of distally directed extraoral force.

MATERIALS AND METHOD: A strain-gauge transducer was used to experimentally determine the distal forces delivered to the inner-bow terminals of the sample facebows, which were designed in different geometric configurations of the outer-bow tips relative to the midsagittal plane of the inner-bow. Measured experimental positions: 1) No asymmetry of activated outer-bow tips, 2) One side is 1 cm shorter, 3) 2 cm shorter (coinciding with the mesial aspect of the molar tube), 4) 3 cm shorter, 5) 4 cm shorter. Each configuration of the facebow was activated with 600 g of tractional force to the outer bow tips. Twenty samples of data were collected on each facebow configuration, and the distal forces on the left and right inner bow terminals were recorded by one author at two different times. Measurement reliability was determined by intra-class correlation coefficient. The results were analysed by one-way variance analysis and Tukey test, and asymmetric effect was calculated.

RESULTS: At positions 2 and 3, the distal force delivered to the inner-bow tip on the long outer bow side increased progressively. At positions 4 and 5 the asymmetric effect decreased.

CONCLUSION: To achieve an asymmetric effect the outer bow should not be shorter than the mesial aspect of the molar tube on the midsagittal plane.

2 COMPARISON OF SKELETAL AND SOFT TISSUE CHANGES FOLLOWING UNILATERAL DISTRACTION OSTEOGENESIS

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AIM: To compare the soft tissue changes of the face with mandibular skeletal changes during the activation and follow-up phases of unilateral mandibular distraction osteogenesis (DO).

SUBJECTS AND METHOD: Fifteen patients, with an average age of 4.5 years with hemifacial microsomia who had undergone unilateral mandibular DO. The measurements were performed on frontal photographs and postero-anterior (PA) cephalograms obtained pre-DO, consolidation, post-DO, and at 1-6 years follow up. For the PA cephalometric measurements, the petrous portion of the temporal bone was averaged with a single horizontal line. A perpendicular vertical line was drawn through crista galli. The gonial distances and ramus heights of both sides, and the occlusal and midline cants were measured. On the photographs, the linear distances between the lip commissures and orbital planes, the angulation of the oral commissure plane and the circumference of both sides of the faces were measured.

RESULTS: Significant improvements were observed in the skeletal and soft tissue bases during the activation, consolidation, and immediate follow-up phases of treatment. However, during the post-DO and follow-up periods, a significant amount of skeletal improvement was lost, although the soft tissue improvement was maintained.

CONCLUSION: A significant relationship was found between changes in soft and hard tissues following unilateral mandibular DO. At the long-term follow-up the amount of soft and hard tissue change was different.

3 EFFECTS OF THALASSAEMIA MAJOR ON COMPONENTS OF THE CRANIOFACIAL COMPLEX

F Amini, S Sharifzadeh, Department of Orthodontics, Azad University, Tehran, Iran

AIM: To investigate the effects of thalassaemia major on the craniofacial complex.

MATERIALS AND METHOD: Cephalometric radiographs, using a standardised technique, were obtained of 30 thalassaemic patients (18 males, 12 females aged 8-12 years) and a control group of 30 non-thalassaemic subjects (20 males, 10 females aged 8-12 years). Forty-three linear and angular parameters were measured on the radiographs and compared between the two groups.

RESULTS: For the angular measurements, ANB showed a statistically significant difference, with a mean of 8.75 ± 2.75 degrees in the thalassaemics and 3.48 ± 1.80 in the controls. Anterior face height (N-Me) was greater in the thalassaemia patients compared with the controls; on average it was 114.39 ± 5.66 and 112.20 ± 11.66 mm, respectively. The difference was statistically significant. The thalassaemic patients showed a reduced anterior cranial base angle (NS-AR); 122.18 ± 6.27 compared with 125.37 ± 3.79 in the controls. The posterior cranial base (S-AR) was reduced in subjects with thalassaemia. The average lengths were 31.38 ± 3.41 and 33.07 ± 4.99 mm, respectively. Effective mandibular length was decreased in the thalassaemics compared with the controls; 39.33 ± 3.88 and 42.63 ± 6.79 mm, respectively.

CONCLUSION: The typical findings in subjects with thalassaemia are a Class II skeletal pattern, increased anterior and reduced posterior vertical dimensions and a short cranial base length that is increased anteriorly and decreased posteriorly.

4 ADAPTATION OF SKELETAL MUSCLE CONNECTIVE TISSUE IN RESPONSE TO STRETCH.

A Auluck, N P Hunt, M P Lewis, Eastman Dental Institute, University College London, England

AIM: The adaptive response of the orofacial musculature is vital to the stability of most orthodontic treatment modalities. The aim of this study was to investigate the *in vitro* response of human craniofacial muscles to stretch conditions that mimic clinical scenarios, using the expression of MMP-2 as a marker of remodelling of the extracellular matrix (ECM) component of muscles.

MATERIALS AND METHOD: Three-dimensional cultures, on collagen sponges, of cells derived from explants of the human masseter muscle were subjected to mechanical stretch using the Bio-Stretch system. The cellular response to different stretch regimes (continuous, cyclical) and amplitudes (40%, 80%) was assessed by investigating the activity of MMP-2 by zymography on the cell-conditioned media. Cell extracts were used to measure creatine phosphokinase (CPK) activity to confirm the presence of myotubes in the stretched cultures.

RESULTS: Scanning electron microscopy of the collagen sponges and CPK assays of cell extracts confirmed the presence of myotubes. Irrespective of the stretch regime or amplitude, MMP-2 was expressed by all the stretched samples and controls, but was found to be significantly higher in those cultures stretched continuously, compared with cyclical stretch, and in those stretched at an amplitude of 80 per cent compared with 40 per cent.

CONCLUSIONS: MMP-2 expression, and hence ECM remodelling is up-regulated in response to stretch and is dependent upon the amount and type of stretch to which the muscle is subjected.

5 MOVING TEETH ORTHODONTICALLY: THE BIOLOGICAL/ MOLECULAR INSIGHT

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KEYNOTE ADDRESS

In order to correct orthodontic/orthopaedic anomalies, mechanical forces are applied to teeth or facial bones and perturbate the balanced process of physiologic bone remodelling, shifting it to resorption or to apposition. When these forces are applied

to teeth they are further transmitted to the periodontal tissues (cells and extracellular matrices) resulting in changes in the architecture of the surrounding bone.

The molecular mechanisms underlying this induced bone remodelling are starting to be unravelled. Data over the last 10 years has revealed that periodontal ligament (PDL) fibroblasts have osteoblast-like properties and bear the potential to differentiate to osteoblasts. It appears that mechanical force application has a pivotal role in this differentiation process. After mechanical stimulation of PDL fibroblasts, specific biochemical events taking place at the plasma membrane and the cytoplasm (small GTP-binding proteins i.e. RhoA, are involved) are ultimately transduced to the nucleus.

This signal transduction process seems to incorporate activation of specific molecular cascades [i.e. extracellular signal-regulated kinase (ERK) and c-Jun N-terminal kinase (JNK) cascades] that involve a variety of transcription factors such as c-Fos, c-Jun, Runx2. The induction of these transcription factors after mechanical stimulation leads to the modulation of genetic programmes that are associated with the mature osteoblast phenotype, and it is in this way that mechanical forces intervene in the bone remodelling process.

6 INFLUENCE OF ORTHODONTIC INTRUSION ON VITALITY OF TRAUMATIZED UPPER INCISORS

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AIM: To investigate the influence of orthodontic intrusion on pulp vitality of previously traumatized upper permanent incisors.

SUBJECTS AND METHOD: One hundred and seventy one patients with 248 traumatized teeth belonging to the following categories: fracture of enamel (n = 67), fracture of enamel-dentine (n = 84), subluxation (n = 31), extrusive or lateral luxation (n = 37), and intrusion (n = 29). The control group included 200 patients with 800 upper incisors with no clinical or radiological signs, and no history of dental trauma. Inclusion criteria were: positive sensitivity testing, a Class II division 1 malocclusion with a deep bite, treatment with a utility type archwire to intrude the upper incisors, and no additional lateral tooth movement of the incisors.

RESULTS: Pulp necrosis was determined in 3.6 per cent of the teeth with a fracture of the enamel-dentine, in 9.7 per cent following subluxation, in 21.6 per cent after luxation and in 27.6 per cent after intrusion injury, the differences compared with the control group (0.25%) being statistically significant ($P < 0.01$). Traumatized teeth with pulp obliteration showed a significantly higher ($P < 0.001$) rate of pulp necrosis (44.1%) than those without signs of pulp obliteration (3.7%) before onset of orthodontic treatment.

CONCLUSIONS: Intrusion of previously traumatized teeth with pulp obliteration has a detrimental effect on pulpal vitality.

7 ASSOCIATION BETWEEN ROOT RESORPTION OF MAXILLARY INCISORS AND PRIMARY MOLARS

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AIM: To elucidate a possible association between ectopic first molar eruption causing root resorption on the distal root of the primary maxillary second molar, and canine eruption causing root resorption of the permanent maxillary incisors.

SUBJECTS AND METHOD: Thirty patients (22 females, 8 males) with an age range of 8.3-15.0 years in whom root resorption of the permanent maxillary lateral and/or central incisor was diagnosed, and clinical and/or radiographic information concerning maxillary first molar eruption existed.

RESULTS: Seven of the patients (23.3 per cent) also had pathologic root resorption of the second primary molar caused by ectopic first molar eruption.

CONCLUSION: It is suggested that patients with ectopic first molar eruption leading to pathologic root resorption of the maxillary second primary molar, are followed closely during the period of premolar and canine eruption, as an ectopic first permanent molar could be an early warning of increased risk of ectopic canine eruption leading to root resorption of the maxillary permanent incisors.

8 LE FORT I – DISTRACTION OSTEOGENESIS VERSUS CONVENTIONAL SURGERY

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AIM: To compare treatment and post-treatment changes, and morbidity in patients with maxillary deficiency after maxillary advancement with Le Fort I distraction osteogenesis (DO) and surgical transposition (S), respectively.

SUBJECTS AND METHOD: Twenty consecutive young adult cleft lip and palate (CLP) patients with maxillary hypoplasia were allocated to two groups, for either a Le Fort I DO with internal distractors or a conventional Le Fort I S. Clinical information and lateral cephalograms were obtained post-operatively after 2 weeks, 3, 6 and 12 months.

RESULTS: The maxilla was moved forward twice as much in the DO group compared with the S group, being 8.1 and 3.9 mm, respectively ($P < 0.05$). The vertical movement did not differ significantly between the two groups. The small (positive) post-treatment changes in both the sagittal and vertical planes were not statistically significant in either group. Clinical complications were observed in three patients in the DO group, i.e. one patient had an intra-operative haemorrhage and two infection around the distractors.

CONCLUSIONS: Both methods resulted in significant forward movement of the maxilla. The results remained stable post-operatively in both groups, despite the fact that the maxilla had been moved forward twice as much in the DO group. This indicates that DO is an efficient method to treat maxillary deficiency in CLP patients. However, the complication rate might be higher in this group.

9 ORTHODONTIC TOOTH MOVEMENT: FROM MECHANICAL STIMULUS TO NUMERICAL BONE REMODELLING SIMULATION

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KEYNOTE ADDRESS

Biomechanical research in the field of orthodontics started in the early 1960s with the work of Burstone *et al.* on the mechanical behaviour of orthodontic appliances and the numerical analysis of teeth under orthodontic loading. Since then the experimental and numerical resources have increased significantly. Nevertheless, we are still far from a full understanding of how the orthodontic load is transferred into a mechanical stimulus within the tooth's socket – the initiating bone remodelling processes. This presentation will summarize recent biomechanical work with the aim of developing a practical and handy simulation tool to predict orthodontic tooth movement.

One critical point within this context is the mechanical behaviour of the periodontal ligament (PDL). Although combined experimental and finite element studies have been carried out in recent years, the elastic properties of the PDL still differ by the power of four or five. This influences the calculated load/deflection behaviour of a tooth under orthodontic loading and the stress/strain distributions around the tooth's root. Additionally, it is still a matter of discussion whether it is stress or strain within the PDL or in the bone that gives the primary mechanical key stimulus to initiate orthodontic bone remodelling. However, the results of combined biomechanical and histological studies of rat molar tooth movement indicate that a direct correlation of

calculated strain values in the PDL with the distribution of osteoclasts in the alveolar bone and the PDL as a factor of tissue reaction to orthodontic force application is possible. Based on this work, bone remodelling theories have been used to simulate tooth movements, using calculated strain values in the PDL as the mechanical key stimulus initiating orthodontic bone remodelling processes.

10 FACIAL AESTHETICS IN PATIENTS TREATED WITH ORTHODONTICS OR SURGERY

V Cacciafesta, M F Sfondrini, F Ceriana, University of Pavia, Italy

AIM: To determine the opinion of six different panels on the facial aesthetics of 40 Class II and III patients. These patients exhibited 'borderline' dentofacial discrepancies: 18 patients (15 females, 3 males, mean age = 30.7 years) were treated orthodontically and 22 patients (16 females, 6 males, mean age = 28.6 years) underwent orthognathic treatment.

SUBJECTS AND METHOD: Two hundred and twenty nine judges (106 females, 123 males, mean age = 34 years) were divided into six different panels (44 orthodontists, 41 maxillofacial surgeons, 26 orthodontic residents, 24 5th-year dental students, 32 4th-year dental students, and 62 laymen). The judges scored the pre- and post-treatment attractiveness on a visual analogue scale using frontal and lateral facial photographs. The judges were not made aware of the aims of the study and there was no indication regarding the treatment modality undertaken. Student's *t*-test and Fisher's exact test were used to compare the patient characteristics, and linear regression models to compare aesthetic outcomes.

RESULTS: There were no significant differences between the two groups of patients in terms of gender, age, skeletal relationships, pre-treatment ANB angle and facial divergence. There were no significant differences in terms of facial attractiveness between the two treatment modalities. Few differences were found between the different panels, although the 5th-year dental students gave significantly lower scores to the orthodontic patients than laymen, and significantly lower scores to the surgical patients than laymen, orthodontists, surgeons, and residents.

CONCLUSION: Judgement of facial aesthetics by laymen appears reliable and is similar to orthodontists and surgeons.

11 GENETIC IMPACT ON FACIAL MORPHOLOGY

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KEYNOTE ADDRESS

If we believe the public-scientific press, single genes have been found responsible for almost every human characteristic in health as well as in disease. This has lead to an oversimplification of genetics in the eye of the general public and to an overestimation of the role that single genes really play. Isolated genes now have a too prominent position in our thinking, which is the result of the recent success of the powerful genetic technology to delineate the genetic base of diseases caused by (a) mutation(s) in one gene. Classical examples are mucoviscidosis and Huntington disease. The simple thinking of '1 gene > 1 disease' has however also been applied too often to more complex human traits and illnesses. A defect in a gene that leads to breast cancer, cleft lip/palate or hypodontia, quickly becomes 'the' gene for breast cancer, cleft lip/palate or hypodontia. These and other complex human characteristics such as intelligence, statural height, language development and many dentofacial characteristics are mostly determined by a large number of genetic factors. Each of these factors leads to an increased liability for a certain condition and it is only when a multiplicity of such hereditary factors is present that the condition has a chance to be expressed. Whether it definitely will be expressed or not, also depends on the environment the individual is exposed to. The function of one gene can thus not be separated from the function of other genes, as they exert their function in a network

and their combined effect is also influenced by the environment. The complex implication of separate genes in gene constellations is often discarded; while the cause of a condition rarely is just one genetic mistake.

The factor 'environment' has to be interpreted very broadly: it is not only about nutrition, but about all possible influences that we undergo since conception and which are not genetic. So the question whether a certain condition or characteristic is genetically 'or' environmentally determined, is a wrong question! It is more correct to ask to which extent they both play a role and also even better how they interact with each other. This is the classical 'Nature -Nurture' debate initiated by Galton in 1870 and in which twin-research sometimes has been misused. The scientific progress in the 19th century resulted in a great belief in 'Nature' (also due to Mendel's experiments), even for features such as talent and character. But when these advances were combined with the evolution theory (Darwin, 1871), the reactions against it were predictable. Consequently, the pendulum of nurture's influence swung so far that it was even claimed that acquired characteristics were heritable. Now at the beginning of 21st century we can speak again of the era of the 'tyranny of the genes'. The exceptional results of present scientific progress again leads to the inclination of the weight towards the direction of nature. The possibilities with genetic testing for population screening for carriers of genetic disease, prenatal screening and prenatal selection (e.g. on the sex of the child), in fact again represent the threat of eugenetics. New insights, in medical as well as in the human sciences, are to be expected via research towards the mutual interaction among genes on the one hand and between genes and environmental factors on the other. Whilst a large amount of work has been carried out in deciphering the blueprint of the human genome, more research will be needed to explain its translation into the actual human phenotype, in health and disease. Therefore, analysis of the human phenotypic variance, especially in twins, will always be necessary in addition to molecular biological techniques in order to explain the expression of specific conditions and characteristics. As most dentofacial characteristics are multifactorial in origin, the collection of detailed clinical data remains equally important compared with DNA analysis in the search for the aetiology and aetiopathogeny of dentofacial traits and characteristics.

12 FINITE ELEMENT ANALYSIS OF VARIOUS TYPES OF ORTHODONTIC TOOTH MOVEMENT

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AIM: According to classical theory, fixed values for the moment-to-force ratio (M/F) have been associated with specific types of orthodontic tooth movement. However, the given M/F values do not account for the complex mechanical properties of the periodontium. The aim of this study was therefore to assess the load transfer mechanism and tooth movement associated with various orthodontic types of loading with a finite element (FE) analysis under the assumption of a non-linear behaviour of the periodontal ligament (PDL) as described in the literature.

MATERIAL AND METHOD: A segment of a lower human mandible containing a canine and a first premolar obtained from autopsy was microCT-scanned. The resulting scans were used for the generation of an anatomically correct FE-model. By varying the moments and forces at the brackets, different orthodontic displacements, e.g. tipping and translation were simulated in a buccal/lingual direction.

RESULTS: The stress distribution in the alveolar bone was dependent on its anatomical morphology, and different values of the M/F resulted in different types of tooth movement. Due to the non-linear behaviour of the PDL, it was, however, also observed that the same M/F with different force magnitudes resulted in different types of movement. Analysis of the stress-strain distribution in the periodontium further showed that the classical patterns of the distribution of compressive and tensile areas in relation to different types of displacement could not be corroborated.

13 BIOMECHANICAL EVALUATION OF MINI-IMPLANTS FOR ORTHODONTIC ANCHORAGE BY FINITE ELEMENT ANALYSIS

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AIM: Mini-implants have been regarded as potential absolute anchorage for orthodontic treatment. The purpose of this mechanical model was to numerically evaluate the bone response to a titanium alloy, screw-shaped orthodontic implant system (Anchorsystem™).

MATERIALS AND METHOD: The implant was constructed on CAD software and subsequently imported to finite element analysis (FEA) software. The implant was placed in bone and the asymmetric analyses were performed under a lateral load of 5 N. The output parameters (failure criteria) evaluated included the first and third bone stress invariants.

RESULTS: The highest stress values were in the bone regions around the implant head, however, these were low compared with those required to induce bone failure. FEA indicated that the 5 N static force, was well distributed by this particular implant design.

14 PERIODONTAL IMPACT OF SURGICALLY INDUCED DENTAL LESIONS IN MANDIBULAR OSTEODISTRACTION

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AIM: To evaluate the repair potential of the dental and periodontal structures after deliberately induced lesions in a canine model of mandibular osteodistraction.

MATERIALS AND METHOD: An osteotomy between the second lateral incisor and canine was performed and a transmandibular distractor placed in six adult Beagle dogs. The proximal roots were deliberately damaged by the reciprocating saw and chisel. The attached gingiva was safeguarded. A standard osteodistraction protocol was used (latency of 7 days, rhythm of distraction 1 mm/day for 5 days). Vital staining was undertaken with tetracycline, xylenol orange and calcein green. The dogs were sacrificed after 12 weeks of consolidation and the specimens evaluated by light microscopy (native, polarized light, fluorescence, and after toluidine blue staining).

RESULTS: Cementum and dentine lesions were consistently repaired by cellular cementum. Loose dentine and cementum-dentine fragments were consistently embedded in regenerated periodontal ligament (PDL) and their surface repaired by cementum. The pulp remained viable when undamaged. Extensive pulp exposure and destruction resulted in ingrowth of the PDL and woven bone. The PDL consistently regenerated, except in one accidental case not directly related to the protocol of the study.

CONCLUSIONS: The PDL consistently regenerated. Cementum repair was extensive. In none of the dogs, was the distraction callus jeopardized by the root lesions.

15 MANDIBULAR IMPLANTS: A HISTOMORPHOMETRIC STUDY IN MINIPIGS

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AIM: Anchorage is one of the most important aspects in planning orthodontic treatment. It may be defined as the 'resistance to unwanted tooth movement' (Proffit 1993). To achieve maximum anchorage, osseointegrated implants have been

described. The subperiosteal Onplant™ has been introduced (Block and Hoffman, 1995) for absolute palatal stability. Because of the anatomical limits in the mandible for intraosseous implants in orthodontic treatment, these implants may be an alternative. The aim of this study was to evaluate the efficacy of subperiosteal Onplants™ for orthodontic anchorage in the mandible.

MATERIAL AND METHOD: Four implants (two on either side) were inserted in the mandible of nine minipigs for a healing period of 3, 6 or 12 weeks.

RESULTS: Nineteen implants were lost during the healing period, leaving 17 for light microscopic and histomorphometric evaluation. Different bone formations were observed around 12 implants. The hydroxyapatite coating of the disc did not show any osseointegrative potential to the underlying compacta. New bone formation was considered to be induced by periosteal elevation. Five implants did not show any implant to bone contact.

CONCLUSIONS: Subperiosteal Onplants™ are suitable to achieve maximum anchorage in the mandibular buccal region during orthodontic treatment. Contacts between the implants and local bone during the healing period were seen as the key factor for success. Therefore stability of the periosteal tube was of primary importance.

16 BIOMECHANICAL ASYMMETRIES OF THE GINGIVAL APPARATUS AND THE PERIODONTIUM

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AIM: Primary crowding prior to orthodontic treatment has been purported to be produced by mesially directed tensions in the dental arch. The initial tooth movement is assumed to show a symmetric behaviour for the distal and mesial tooth rotations following respective torques. Both assumptions were examined *in vivo*.

SUBJECTS AND METHOD: Twenty-two subjects with natural tooth spacing and 16 patients with pronounced anterior crowding were examined using a newly developed sensitive device for measuring small displacements ($< 0.5 \mu\text{m}$) following time dependent torques between $\pm 1.43 \text{ Ncm}$.

RESULTS: Subjects with natural spacing did not show any statistically significant differences between distal and mesial displacements of the crown, but distal/mesial symmetric thresholds were found that had to be overcome by applied torque to rotate the crown mesially or distally. Pronounced anterior crowding, however, led to significant asymmetry: the threshold of the applied torque to rotate the tooth distally was significantly higher than to the mesial. In both groups, the mesially and distally measured stiffness did not show any statistically significant difference.

CONCLUSIONS: Mesially directed pre-tensions in the gingival fibre apparatus may be attributed to the asymmetry and thixotropic properties of the periodontium. In the light of these facts finite element analysis calculations should be revised.

17 HIGH-RESOLUTION MICROTOMOGRAPHY OF ALVEOLAR SUPPORT TISSUES

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AIM: Orthodontic tooth movement is possible as the alveolar bone surrounding the root undergoes modelling due to the altered mechanical environment induced by orthodontic loading. Transfer of load from tooth to bone depends on geometry and material properties of the alveolar tissues. Little is known about the three-dimensional (3D) architecture of the alveolar wall. The aim of this study was to describe the shape of the alveolar structures by means of high-resolution microcomputer (microCT) scanning and subsequent 3D reconstruction.

MATERIAL AND METHOD: A segment of a human mandible containing an incisor, a canine and a premolar was scanned with a synchrotron-based microtomograph at a spatial resolution of 11 μm . As synchrotron radiation is monochromatic, no beam-hardening artefacts occur and grey-values in the scans are directly related to local tissue densities.

RESULTS: The thickness of the lamina dura was 1-2 times that of the periodontal ligament. The alveolar surface of the lamina dura was not smooth, but displayed multiple perforations. The irregularity was significantly more pronounced cervically, whereas the density of the trabecular bone supporting the lamina dura was smallest near the apex of the root.

CONCLUSION: High-resolution microCT scanning enables visualisation of the shape and structure of alveolar support tissues from which new insights into the mechanics of orthodontic load transfer and tooth movement may arise. Based on the findings, a reduction of the magnitude of orthodontic forces is suggested.

18 TREATMENT OUTCOME OF EARLY AND LATE PALATAL CLOSURE IN UNILATERAL CLEFT LIP AND PALATE PATIENTS

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AIM: To evaluate the effect of early or late surgery on the dental arch relationship in two groups of consecutive unilateral cleft lip and palate patients.

SUBJECTS AND METHOD: Group A (Catholic University of Louvain, n = 23) closure of the hard and soft palate at 4 months of age and group B (University Medical Centre Nijmegen, n = 51) closure of the soft palate at 18 months and closure of the hard palate at 9 years of age. Dental casts in centric occlusion of all 9-year-old patients were trimmed in the same manner to avoid identification. Sixteen models were duplicated and mixed with the other models to evaluate intra-observer reliability. The dental arch relationship was assessed on the models with the Goslon Yardstick, which scores the dental arch relationships into five categories from 1 (very good arch relationship) to 5 (need for surgery). A blind examination was carried out by six observers, four of whom were familiar with the scoring technique, whilst two had no previous experience.

RESULTS: Intra-observer reliability was very good (lowest rate 97.2%, highest 99.5%). The inter-observer reliability was also good (two observers had an overall mean score of 2.3; two observers 2.4; the mean overall score of the two non-experienced observers was 2.1 and 2.6). The overall value for group A was 3.0 (\pm SD 0.9) and 2.3 (\pm SD 0.7) for group B ($P < 0.002$).

CONCLUSION: Using the Goslon Yardstick method the dental arch relationship of the models was found to be better for the group with late closure of the palate than for the group who had undergone early surgery.

19 CARIES-INHIBITING EFFECT OF PREVENTIVE MEASURES DURING FIXED APPLIANCE THERAPY

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AIM: To perform a systematic review of published data on the caries-inhibiting effect of preventive measures during orthodontic treatment with fixed appliances, and to develop evidence-based recommendations concerning the most effective means of preventing white spot lesions in orthodontic patients.

MATERIALS AND METHOD: A literature search was executed in PubMed and Medline. The 15 studies included were divided into four groups based on comparable preventive measures: fluoride, chlorhexidine, sealants and bonding materials. The

caries-inhibiting effect of the preventive measures was expressed by the prevented fraction (PF).

RESULTS: The overall PF of the fluoride-releasing bonding materials was 20 per cent (standard error of the mean: 0.09). This effect was, however, not statistically significant. It was impossible to calculate an overall PF for the other preventive measures, but the tendency of their caries-inhibiting effect has been described. The use of toothpaste and gel with a high fluoride concentration of 1500-5000 ppm or of complementary chlorhexidine during orthodontic treatment showed a demineralisation-inhibiting tendency. The use of a polymeric tooth coating on the tooth surface around the brackets showed almost no demineralisation-inhibiting effect. Many publications had to be excluded from this systematic review because of inadequate research designs.

CONCLUSIONS: Future clinical trials are needed to provide evidence-based advice on the optimal caries-prevention strategy.

20 ORTHODONTIC BONE ANCHORS: A 4-YEAR CLINICAL EVALUATION (*)**

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AIM: To evaluate the success rate of a modified titanium miniplate for anchorage in six orthodontic applications.

SUBJECTS AND METHOD: Two hundred and four bone anchors placed in 164 patients for the treatment of the following discrepancies: distal movement of the anterior segment with (87) or without (52) extractions, uprighting of mesialised lower molars (23), intrusion of teeth (6), mesial movement of posterior teeth (12), and Class III orthopaedic traction (24). The following force applications were used: 150 g for canine retraction; 200 g on sliding jigs for molar distalization; 0.016 × 0.022-inch stainless steel coil springs to upright lower molars; 150 g Sentalloy springs for intrusion; 2 × 350 g Class III orthopaedic traction. Evaluation of the chair time needed, treatment time and stability of the bone anchors were also recorded.

RESULTS: The bone anchors were loaded over a mean period of 8.8 months (SD: 3.2 months). Four bone anchors were lost in the upper and five in the lower jaw for the following reasons: local infection due to a communication with a periodontal pocket, poor oral hygiene, late initial loading or bad surgical positioning. The results indicated that correction of Class II occlusions with or without extractions is readily achieved and needs a short treatment time; mesial movement of the molars and intrusion of teeth was efficient but more time consuming; control during molar uprighting was difficult and Class III orthopaedic traction was easy with limited discomfort for the patients.

CONCLUSION: The parameters determining the success of a miniplate as an anchorage tool are accurate surgical positioning, good oral hygiene, and early loading.

21 IS BODILY ADVANCEMENT OF RETRUDED LOWER INCISORS POSSIBLE?

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AIM: Class II malocclusions are characterized by retrusion of the lower dental arch. The aim of this research was to displace the lower dental arch anteriorly on the mandibular base during activator treatment, by means of labial root torque and reverse headgear.

SUBJECTS AND METHOD: Fifty-three growing individuals with skeletal Class II malocclusions randomly assigned to two treatment groups: a) activator combined with fixed appliance in the lower arch, with labial root torque on the incisors and application of anterior forces by reverse headgear (RHG n = 27), and b) activator

combined with headgear on the upper molars (Control n = 26). All patients had a second phase of fixed appliance treatment. Cephalograms were taken at three intervals: T1 at the start, T2 after the first stage and T3 at the end of active treatment. RESULTS: In the RHG group, the lower incisor edge was more prominent, Pogonion was less advanced, and the width of the symphysis did not increase in comparison with the control group. The lower incisors showed labial tipping instead of the desired bodily advancement. As a consequence, the lower lip was more protruded and the chin was less prominent in the RHG group. At T2 the differences were more marked than at T3, but small, clinically significant differences were still present. CONCLUSION: In selected Class II malocclusion subjects with a strong chin and marked labiomental fold, the use of reverse headgear has a positive aesthetic impact, though no anterior displacement of the alveolar base of the incisors should be expected.

22 VALIDITY AND RELIABILITY OF A PORTABLE THREE-DIMENSIONAL OPTICAL SCANNING DEVICE

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AIM: To assess the validity and reliability of a three-dimensional ((3D) optical laser scanning device in recording 3D facial morphology and dental study models.

MATERIALS AND METHOD: The facial morphology study used live and inanimate objects. Scans were obtained of: a cube of known volume, a life size phantom head and 30 clinical subjects using two portable Minolta VIVID900 laser scanners, assembled as a stereo pair in a reproducible and controlled environment. Using one Minolta VIVID900 laser scanner, a turntable, and the integrating software Easy3DScan, 30 dental study models were scanned, at a fixed object-to-scanner distance. Measurements were conducted directly on the actual surfaces and on the scanned images to establish the reliability and validity of the laser acquired images.

RESULTS: Analysis of the images demonstrated that the parameters measured by the laser scans did not differ significantly from the actual object measurements. The average error for the length, breadth and depth of the cube were 0.12 per cent (0.09-0.20%), 0.2 per cent (0.21-0.37%) and 0.87 per cent (0.78-0.96%), respectively. The images of the scanned dental study models were accurate to 0.18 mm (SD = 0.13), 0.19 mm (SD = 0.10) and 0.48 mm (SD = 0.25) in the X, Y and Z planes, respectively.

CONCLUSION: The findings suggest the Minolta VIVID900 laser scanner is a valid and reliable device for acquiring 3D images of live and inanimate objects.

23 OUTCOME MEASUREMENT IN THE CORRECTION OF MANDIBULAR ASYMMETRY

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AIM: To clinically assess the severity of mandibular asymmetry using a series of computerized measurements, obtained by digitizing mandibular outlines from standardized facial photographs.

MATERIALS AND METHOD: Four ratios were calculated: area (i.e. size); compactness (shape); perimeter (length of outline); and moment, or centre of area. When comparing clinical severity with computer assessment, significant correlations were observed, with those for area and compactness being highest. Sixteen patients subsequently underwent corrective surgery and their ratios were used to relate the degree of improvement to the original severity of the asymmetry. The post-treatment ratios were also used to 'audit' the outcome, comparing the patients scores as a group with results previously obtained from patients with 'normal' and 'mild' levels of asymmetry.

RESULTS: Post-treatment outcomes were significantly different from the normal outline group but were comparable with those in patients with mild mandibular asymmetry.

CONCLUSION: The system provides a sensitive, non-invasive method of assessing treatment change and could be useful in providing an objective means of quantifying treatment outcomes.

24 DENTOFACIAL AESTHETICS IN ADULT CLEFT LIP PALATE PATIENTS

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AIM: To determine treatment outcome following surgery in subjects with a unilateral cleft lip and palate (UCLP).

SUBJECTS AND METHOD: One hundred and nine patients with a UCLP followed up to 30-40 years of age. All had undergone a Tennison lip closure and a vomer flap for repair of the anterior hard palate at 3 months of age, and a Wardill-Kilner pushback for the palate at 22 months of age. Bone grafting of the alveolar process defect was performed in the mixed dentition. Of these subjects, 40 were treated orthodontically with a maxillary closed dental arch, and in a further 47 patients, the treatment was finished with bridgework. Orthognathic surgical treatment was necessary in 22 patients. The treatment outcome was evaluated based on lateral and postero-anterior (PA) cephalograms and standardized facial photographs.

RESULTS: In the sagittal plane, the treatment results were very satisfactory with, in most cases, a positive overjet. PA cephalograms revealed an impairment of maxillary vertical growth in the cleft side resulting in a canting of the transversal occlusal plane, and, in most cases, a tilting of the maxillary incisors. Transversal occlusal stability was noted in 79 per cent of the patients with fixed dental bridgework, but 65 per cent treated orthodontically with a closed dental arch required permanent retention.

25 ORTHOGNATHIC SURGERY AND DENTOFACIAL ORTHOPAEDICS IN ADULT CLASS II DIVISION 1 TREATMENT

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AIM: To assess the extent to which adult Herbst treatment is an alternative to orthognathic surgery by comparing the dentoskeletal treatment effects in 46 adult Class II division 1 subjects treated with a combined orthodontic-orthognathic surgical approach (mandibular sagittal split osteotomy without genioplasty) and 23 adult Class II division 1 subjects treated with the Herbst appliance.

MATERIALS AND METHOD: Lateral head films in habitual occlusion from before and after treatment (i.e. after multibracket appliance treatment following surgery and Herbst treatment, respectively) were analyzed. All surgery and Herbst subjects were treated successfully to a Class I occlusal relationship with a normal overjet and overbite.

RESULTS: In the surgery group the improvement in sagittal occlusion was achieved by more skeletal than dental changes, while in the Herbst group the opposite was the case. Skeletal and soft tissue facial profile convexity was significantly reduced in both groups. The amount of profile convexity reduction was, however, larger in the surgery group than in the Herbst group. The success and predictability of Herbst treatment for occlusal correction was as high as for surgery.

CONCLUSION: Herbst treatment could be considered as an alternative to orthognathic surgery in adult subjects with a borderline skeletal Class II malocclusions, especially in those in which a large facial improvement is not the main treatment aim.

26 EN MASSE RETRACTION WITH ZYGOMATIC ANCHORAGE

AIM: To evaluate the effectiveness of using zygomatic anchorage in en masse retraction.

SUBJECTS AND METHOD: Ten patients with an average age of 24 years with maxillary prognathism. In six subjects the upper first premolars were extracted, and in the remaining four subjects the upper first and lower second premolars. Zygomatic implants with ball ends were fixed on the anterior margin of the inferior zygomaticomaxillary buttress. The upper first premolars were extracted after completion of the levelling process. A stainless steel rectangular archwire was bent to fit the maxillary anterior region including the canines and it was bent towards the apical direction just distal to the canine bracket. At the level of the estimated centre of resistance (CR) of the anterior segment a helix was bent and the archwire was extended towards the distal direction. The horizontal arm of the archwire was adjusted to pass through the tube in the ball end of the zygomatic implant. When necessary, a step was bent on the archwire to adjust the level of the horizontal arm vertically. NiTi coil springs were applied bilaterally between the wire extensions distal to the ball ends and the helices bent on the horizontal arms.

RESULTS: The overjet was corrected successfully without any anchorage loss.

CONCLUSIONS: The above procedure works well when the force is applied through the CR of the anterior segment. Individual definition of the CR will increase the success of the method.

27 NICKEL IN DENTAL PLAQUE AND SALIVA

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AIM: To test for higher nickel content in saliva and dental plaque of orthodontic patients compared with non-orthodontic patients.

MATERIALS AND METHOD: Unstimulated saliva and dental plaque from 24 boys and girls with, and 25 without fixed orthodontic appliances. The set-up at sample collection included dietary records for the last 48 hours. Analysis for nickel in the samples and blanks was carried out according to the EAAS method. The saliva samples, dissolved in acids, were analysed as size-filtered saliva and saliva filtrate, and the plaque assessed following dissolution in acids.

RESULTS: The median amount of nickel in the filtered saliva of orthodontic patients was 0.005 µg/ml, and 0.004 in their controls, without a significant difference between the groups. In filtrates of saliva the median amount of nickel was 25.25 and 14.85 µg/ml, respectively, with a significant difference between the groups. In plaque the median content of nickel amounted to 0.69 µg/g in samples from orthodontic subjects and 0.42 µg/g from the controls, with a difference when comparing plaque samples collected from enamel surfaces. An even greater difference was found when samples collected from metal surfaces of patients were tested against the plaque samples of controls, as well as when comparing plaque from enamel and metal surfaces of teeth within the appliance group. No association with dietary intake could be demonstrated.

CONCLUSION: A significantly higher nickel content can be found in filtrates of saliva as well as in the dental plaque of subjects with an orthodontic appliance compared with patients without an appliance.

28 EARLY IMPLANTATION AND AESTHETICS IN JUVENILE PATIENTS WITH DENTAL AGENESIS

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AIM: To study the stability, position, and dental aesthetics of implants in the mandible during growth in juveniles with agenesis and to present a three-phase

protocol for the therapy of patients with multiple tooth agenesis: (i) Orthopaedic improvement of the vertical jaw relationship; (ii) Fixed appliances and implants in the mandible; (iii) Alignment of the upper teeth and insertion of maxillary implants after completion of growth.

SUBJECTS AND METHOD: Nineteen juvenile patients (13 females, 6 males) with a mean age of 12.8 years (minimum: 9.7; maximum: 14.9) entered the second phase of treatment in which dental implants were inserted in the mandible during therapy with fixed appliances. A follow-up investigation was undertaken at least two years after implant insertion.

RESULTS: A total of 49 implants were inserted: 28 in the anterior region and 21 in the premolar region. Two implants showed a vertical deficit necessitating a localized distraction osteogenesis procedure.

CONCLUSION: Early restoration using implants improves juveniles' self esteem. Implants may be used for skeletal anchorage during fixed appliance therapy. Early implantation preserves the bony support that might be lost if removable prostheses were used. However, if the alveolar crest shows growth deficit, localized vertical distraction osteogenesis may be undertaken.

29 CHANGE OF INTRACELLULAR ELEMENTS IN MASTICATORY MUSCLES AFTER PARALYSIS OF THE RIGHT MASSETER MUSCLE

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AIMS: Ion concentrations are an important factor in muscle contraction. Paralysis or load causes changes of muscle fibre types and remodelling of the myosin heavy chains. The aim of the present investigation was to investigate ionic change in the masticatory muscles following the onset of paralysis.

MATERIALS AND METHOD: Fourteen week-old pigs (7 test and 8 controls) were investigated over a 56-day treatment period. The right masseter muscle was paralysed using botulinum toxin A (Botox). Muscle tissue was taken from the masseter (M1, M2, M3), temporal (TP1, TP2), medial pterygoid (PM) and geniohyoid (GH) muscles by a standardized method. Muscle fibre samples were then subjected to histological examination and energy-dispersive X-ray microanalysis, using an environmental scanning electron microscope. Muscle stress was detected as changes in type I fibres and ion concentrations.

RESULTS: Treatment of the masseter with Botox resulted in a decrease of type I fibres compared with the control group ($P < 0.05$). The control group also demonstrated smaller changes in potassium, sulphur, chloride and even larger changes in phosphate and sodium were measured. In the Botox treated masseter muscle, reverse changes in the concentration of elements occurred.

CONCLUSION: The results reveal the effects of chronic stress on muscle fibres and ion concentration. The increase of type I fibres is considered to be an indicator of more efficient contraction and may therefore represent a compensatory mechanism in muscle paralysis.

30 DEGREE OF CURE, MONOMER LEACHING AND CYTOTOXICITY OF LIGHT- AND CHEMICALLY-CURED ADHESIVES

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AIM: To estimate the degree of cure (DC) and monomer leaching of a light- and a chemically-cured (no-mix) adhesive and to assess their cytotoxicity.

MATERIALS AND METHOD: The DC of adhesive specimens prepared with a procedure identical to the clinical bonding process, was assessed by infrared spectroscopy. The residual monomer leaching from the adhesives following immersion in saline for 2 months was analyzed with liquid chromatography. The

immersion media were then applied to human gingival fibroblasts and their potential cytotoxicity was studied with the MTT and DNA synthesis assays. The results were analyzed with ANOVA and Tukey's test ($\alpha = 0.05$).

RESULTS: No difference was found between the two adhesives with respect to their DC and amount of tetraethyleneglycol dimethacrylate released, and no Bis-GMA monomer was detected in the eluent. Nonetheless, significant qualitative changes in the composition of the substances eluted from the two adhesives were observed, assigned to the differences in the molecular configuration and initiator systems. Whilst no acute cytotoxic effect was shown for either immersion media, a reduction in DNA synthesis was obtained by both adhesives, implying a cytostatic effect.

CONCLUSION: Further research is required to assess the long-term biological properties of adhesives, including potential oestrogenic action.

31 OSTEOCLASTIC APOPTOSIS: DECOY OLIGODEOXYNUCLEOTIDES TARGETING NUCLEAR KAPPA BETA TRANSCRIPTION FACTORS

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AIM: To examine *in vitro* the effect of decoy DNA/DNA molecules targeting the nuclear factor kappaB (NF- κ B) on apoptosis of human osteoclasts (OCs), in order to interfere with the pathway regulating osteoclast differentiation and programmed cell death.

MATERIALS AND METHOD: Human primary OCs were prepared from culturing peripheral blood mononuclear cells, for 14 days, in the presence of receptor activator of NF- κ B ligand (RANKL), macrophage colony-stimulating factor (M-CSF) and parathyroid hormone (PTH). OCs were transfected with the double-stranded decoy molecules mimicking the NF- κ B binding sites present in the LTR of the HIV-1, complexed with PC:DOTAP cationic liposomes, respectively, for 24, 48 and 72 hours. Apoptosis was examined by TUNEL staining and confirmed by induction of Caspase-3 and inhibition of IL-6 expression.

RESULTS: In primary cells expressing typical osteoclast markers such as TRAP and MMP9, NF- κ B decoys significantly stimulated programmed cell death at a very early stage with more than a 13-fold increase in the percentage of apoptotic OCs.

CONCLUSIONS: Using the above-mentioned approach in clinical orthodontics, it could be possible to alter the life span of OCs. In this respect, the decoy approach could be an effective novel biological means to control osteoclastic resorption during orthodontic tooth movement.

32 NASOALVEOLAR MOULDING AND PRE-SURGICAL COLUMELLA ELONGATION IN UNILATERAL AND BILATERAL CLEFTS OF THE LIP ALVEOLUS AND PALATE

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KEYNOTE ADDRESS

Pre-surgical infant orthopaedics has been employed since the 1950's as an adjunctive neonatal therapy for the correction of cleft lip and palate. In this lecture, a paradigm shift from the traditional methods of pre-surgical infant orthopaedics will be presented.

One of the problems that the traditional approach fails to address is the deformity of the nasal cartilages in unilateral as well as bilateral clefts of the lip and palate (BCLP), and the deficiency of columella tissue in infants with bilateral clefts. The nasoalveolar moulding (NAM) technique utilizes wire and acrylic nasal stents, attached to the vestibular shield of an oral moulding plate to meld the nasal alar cartilages into normal form and position during the neonatal period. This technique takes advantage of the malleability of immature cartilage and its ability to maintain a permanent correction of its form. In addition, the ability to non-surgically elongate the columella

in BCLP, through the application of tissue expansion principles, will be demonstrated. This is performed by gradual elongation of the nasal stents and the application of tissue expanding elastic forces that are applied to the prolabium. Utilization of the NAM technique has eliminated surgical scars associated with traditional columella reconstruction and has become the standard of care at the Institute of Reconstructive Plastic Surgery, New York University Medical Center. This new pre-surgical infant orthopaedic treatment protocol, combined with gingivoperiosteoplasty, has been demonstrated to reduce the number and cost of surgical interventions.

33 INFLUENCE OF DONOR SITE ON TOOTH TRANSPLANTATION

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AIM: To examine the influence of the donor site on the results of third molar transplantation.

MATERIALS AND METHOD: Thirty-four transplanted immature third molars in 32 patients (21 females, 11 males). In 11 patients the maxillary third molars were transplanted in the maxilla and in eight subjects in the mandible. In 15 cases transplantation of mandibular third molars was carried out in the mandible. Splinting was undertaken with rigid vestibular acid-etch composite and a wire splint for 4 weeks. All transplants were followed clinically and radiologically for a mean observation period of 3.4 years (range 1.0-6.1 years).

RESULTS: The success rates were 86.7 per cent for transplantation of mandibular third molars in the mandible, 81.8 per cent for transplantation of maxillary third molars in the maxilla, but only 25 per cent for transplantation of maxillary third molars in the mandible. Statistically significant differences were found between transplantation of maxillary third molars in the mandible, and maxillary third molars in the maxilla ($P = 0.024$) or mandibular third molars in the mandible ($P = 0.006$).

CONCLUSIONS: The direction of transplantation seems to be an important factor for the success of third molar transplantation after prolonged rigid fixation. A possible explanation could lie in an incongruity between recipient site and root morphology of the transplanted tooth leading to impairment of pulpal revascularization.

34 TREATMENT ESSENTIALS FOR IMPROVEMENT OF JAW-BASE RELATIONSHIP IN CLASS II SUBJECTS

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AIM: The amount any individual can be expected to grow may or may not depend on the particular form of treatment (Johnston, 1999). The aim of this study was to investigate the apical-base change with various treatments of a Class II malocclusion

SUBJECTS AND METHOD: Three patient groups were compared: (1) the 'gold standard' group: Edgewise therapy (Johnston, 1999), (2) Class II elastic group: 18 consecutive subjects, non-extraction with Begg, and (3) Headgear-functional appliance group: 18 consecutive subjects, headgear-Herbst and step-wise advancement of the mandible followed by a headgear-activator. Lateral cephalograms were obtained for all groups at the start of treatment (T0), and after 6 (T6), 12 (T12) and 18 (T18) months (groups 2 and 3), and after 24 months (group 1).

RESULTS: The antero-posterior (A-P) distance had improved 2.3 mm*** in group 1 after 24 months. In group 2 it worsened 0.5 mm at T6, improved 0.4 mm at T12 and 1.1 mm** at T18. In group 3 it had improved 3.1 mm*** at T6, 5.6 mm*** at T12 and 6.3 mm*** at T18. At T24 the groups had 74, 41 and 36 per cent of A-P change versus the groups at T6, T12 and T18. Group 1 had 20 per cent of the A-P change of group 3 at T18.

CONCLUSION: The choice of orthodontic device used for improvement of the apical base relationship in the treatment of Class II malocclusions seemingly matters to a clinically significant level. However for some orthodontic devices the treatment change of A-P distance might not differ significantly from that of growth only.

35 DO SUPERELASTIC WIRE PROPERTIES CHANGE AFTER HEAT OR ELECTRICAL TREATMENT?

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AIM: In some orthodontic treatments superelastic wires are bent by either heat or the use of electric pliers. Little is known however about if and how this affects the mechanical properties of the wire. It was, therefore, the aim of this study to assess the change in wire properties following heat and electrical treatment.

MATERIALS AND METHOD: Four types of orthodontic wires, Copper Ni-Ti® 27 and 40, Neo-Sentalloy® 100 and Ni-Ti®, were bent in the 1st, 2nd and 3rd order by mounting them in specially constructed rigs and heating these up to 498°C. After 5 minutes in the oven the wires were either air- or water-cooled to room temperature. Subsequently the wires were tested at mouth temperature (36°C) in a force system identification apparatus. The applied force system was such that the deformed wires were brought back to their original shape. The opposite loading mode was applied to wires that had been heat- or electrically-treated without bending them. Finally the same loading was applied to control wires that had not been exposed to any type of treatment.

RESULTS: Heat, cooling, and electrical treatment substantially affected the characteristics of all tested wires. In particular the superelastic force plateau was reduced after the combination of bending and heat treatment, and in some cases it was lost completely.

CONCLUSION: Thermo-elastic orthodontic wires loose their superelasticity after bending followed by heat or electrical treatment.

36 MANDIBULAR ADVANCEMENT IN CLASS II DIVISION 1 MALOCCLUSIONS (*)**

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AIM: To compare the skeletal effects of the growth guide appliance (GGA) with the effects of posterior high pull headgear (HG).

SUBJECTS AND METHOD: Twenty-five GGA-patients (aged 10.27 ± 0.94 years) and 27 HG-patients (aged 10.42 ± 1.04 years). The GGA is a modified headgear with a vertical bar bearing adjustable twin pads located in the lower lip sulcus. Only patients treated between 1992 and 2002 with either the GGA or HG appliances were compared. One hundred and four lateral cephalograms taken pre- and post-treatment were analysed. Thirty-two parameters were measured. For analysis of mandibular growth, the cephalograms were superimposed on Menton-Gonion (x -axis), and a perpendicular through Pogonion (y -axis). The mean observation period was 1.9 years. For statistical analysis, the data were normalized to 1 year differences. Differences between the two groups were tested using the Mann-Whitney U test.

RESULTS: The annualized increase of SNB angle was significantly higher in the GGA group ($0.69^\circ/\text{year}$) than in the HG-group ($0.12^\circ/\text{year}$) ($P < 0.001$). Local superimposition of the mandible on the pre- and post-treatment cephalograms showed significantly more mandibular growth per year, measured as the distance Condylion-Pogonion, in the GGA-group (3.35 mm/year) than in the HG-group (2.16 mm/year) ($P < 0.001$).

CONCLUSION: The GGA enhances mandibular advancement in growing patients with a Class II division 1 malocclusion.

37 CHANGES IN MAXIMUM VOLUNTARY BITE FORCE AFTER ORTHOGNATHIC SURGERY

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AIM: To determine the effect of orthognathic surgery on maximum bite force and on the activity of masticatory muscles.

SUBJECTS AND METHOD: Thirty patients for whom orthognathic surgery was planned and 16 controls who were skeletally and dentally Class I. Bite force measurements were obtained with a bite force transducer just before surgery and 3 and 6 months after surgery. Twenty-three patients were also measured 1 year after surgery. Electromyographic records were obtained from nine of the patients and 11 of the controls during maximal biting in the intercuspal position, before surgery and 3 and 6 months after surgery.

RESULTS: The pre-surgical mean maximum bite force was 170.80 ± 18.96 N for the patients. This decreased 3 months after surgery, reached pre-surgical values at 6 months and exceeded them in the first year. The bite force of the controls was significantly higher than that of the patients both before surgery and at all periods after surgery. Surgery had no effect on the activity of the muscles except the right masseter whose activity increased 6 months after surgery.

CONCLUSION: The bite force of the patients remained significantly lower than that of the controls even 1 year after surgery. Except for the right masseter, the activity of the masticatory muscles did not show an improvement 6 months after surgery. Long-term studies are necessary in order to ascertain whether further improvement will take place both for bite force and muscle activity.

38 SAFE ZONES: A DIAGNOSTIC APPROACH FOR MINISCREW ANCHORAGE SYSTEMS

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AIM: Mini-screws as absolute anchorage are widely used in orthodontics. The choice of the anatomic areas of insertion is critical to ensure a successful outcome. The aim of this study was to evaluate statistically if the areas usually selected for mini-screws placement are anatomically adequate.

MATERIALS AND METHOD: Three-dimensional images of 50 maxillae and 50 mandibles were retrieved from a pool of 200 patients, between 20 and 40 years of age. The data were obtained with a new type of tomogram, the 'Newtom System', based on a cone beam. Seven areas were evaluated in the maxilla and four in the mandible. For each area mesio-distal and labio-lingual measurements from four horizontal cuts were made at 2, 5, 8, and 11 mm below the bone-crest. A total of eight measurements for each area were obtained. These measurements were repeated three times by the same operator and the mean value was calculated. Statistical analysis was used for interpretation of the data. Bone density of cortical as well as spongy areas of the selected sites was also evaluated.

RESULTS: In the mandible the highest amount of alveolar bone was in the mesio-distal dimension between 6 and 7 (minimum 3.0 mm at -5 mm cut; maximum 4.7 mm at -11 mm cut). The smallest amount of bone was recorded between the lower 3 and 2 (minimum 2.0 mm; maximum 3.2 mm). In the labio-lingual dimension the highest thickness was between 6 and 7 (minimum 10.4 mm at -2 mm cut; maximum 13.4 mm at -11 mm cut). The smallest amount of bone was between 3 and 2 (minimum 6.7 mm; maximum 7.3 mm). In the maxilla the highest amount of bone was in mesio-distal dimension between 6 and 5 on the palatal side (minimum 1.9 mm at -11 mm cut; maximum 5.5 mm at -5 mm cut). The smallest amount of bone was in the tuberosity (minimum 0.2 mm; maximum 1.3 mm). Examination of the labio-palatal dimension demonstrated a similar high thickness between 5-6 and 6-7 (minimum 3.7

mm at -11 mm cut; maximum 13.2 mm at -2 mm cut). The smallest amount of bone was recorded on the tuberosity (minimum 0.6 mm; maximum 4.1 mm).

39 EVALUATION OF PERIODONTAL STRUCTURES FOLLOWING DENTOALVEOLAR DISTRACTION OSTEOGENESIS

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AIM: Duration of orthodontic treatment time and use of extra oral anchorage appliances are the most complained of matters in orthodontics. To overcome these problems, rapid canine retraction using the principles of distraction osteogenesis (DO) was used and the long-term effects on the dentofacial structures and periodontal tissues studied.

SUBJECTS AND METHOD: Twenty canines of 12 subjects with a mean age of 16.53 years. The canines were moved rapidly into the sockets of the extracted first premolars following minor surgery. Plaque index (PI), gingival index (GI), pocket depth (PD) and root resorption scores were analyzed before and after DO and at the end of a 12 month follow-up period.

RESULTS: The distraction procedure was completed in 8-14 days at a rate of 0.8 mm/day and the anchorage teeth were able to withstand the retraction forces without any anchorage loss. Most of the patients finished their orthodontic treatment within 12 months with no clinical or radiographic evidence of complications such as root resorption, ankylosis, or loss of vitality. The mean scores for PI and GI were low throughout the 12 months period. The PD measurements at three sites other than the buccal site were significantly increased by DO ($P < 0.05$ and $P < 0.001$), however decreased to normal limits during the follow-up period.

CONCLUSION: DO is an innovative method for shortening orthodontic treatment time with no need for extra- or intra-oral anchorage devices and without any unfavourable long-term effects on the periodontal tissues of the retracted canines.

40 SOFT TISSUE PROFILE OF CHILDREN WITH IMPAIRED NASAL BREATHING

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AIM: To evaluate the soft tissue profile of children with impaired nasal breathing.

MATERIALS AND METHOD: Soft tissue points relative to the true vertical line were measured on the lateral cephalograms in natural head position of 54 subjects with diagnosed nasal obstruction (34 males, 20 females, mean age 13.3 ± 2.7 years). Thirty-three patients (19 males, 14 females, mean age 13.4 ± 2.7 years) receiving orthodontic treatment for different types of malocclusion served as the controls. Nasal airflow measurements were performed for all children.

RESULTS: Both groups had a retrognathic soft tissue profile; there were, however, no statistically significant differences between the groups for the linear and angular soft tissue measurements. The soft tissue profile correlated with the changes in cranio-cervical posture. Upper lip projection and upper lip angle were dependent on all postural angles (NS/Vert, Ort/NS and Ort/Hor) at $P < 0.001$, while soft tissue A, B, Pg and lower lip projection were dependent on NS/Vert and Ort/NS. Nasiolabial angle changed only with age.

CONCLUSION: The soft tissue profile of children with impaired nasal breathing in general is not different from that of other orthodontic patients and is mostly dependent on cranio-cervical posture.

41 THE EFFECTS OF AN ASYMMETRIC QUADHELIX ON THE MAXILLARY ARCH

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AIM: To assess changes in upper dental arch symmetry and length as well as rotation of the first molars resulting from the application of a quadhelix with differing lateral arm lengths in patients with asymmetric upper dental arches.

SUBJECTS AND METHOD: Twenty children with an average age of 9.5 years with a crossbite and upper dental arch asymmetry were treated with a quadhelix with differing lateral arm lengths: the shorter arm touched the teeth in crossbite and the contralateral arm extended forward and followed the curve of palatal surfaces of the lateral teeth and incisors. The distances from the central grooves of the first molars to the palatal suture, and arch length as well as rotation of the first molars, were measured on photocopies of pre- and post-treatment study models.

RESULTS: Before treatment the upper dental arch had an asymmetric shape in all subjects. The average width of the less developed side was 19.65 mm, and the wider side 22.3 mm ($P < 0.001$). After treatment the average width of the side of the shorter arm was 22 mm and the contralateral side 23.7 mm ($P < 0.003$). The length of the upper arch increased by 0.2 mm ($P < 0.01$). The first molars rotated slightly more distally (on average 4°) at the side of the shorter arm than at the contralateral side (3° ; $P < 0.1$). The rotation depended on the rate of expansion ($R_s = 0.48$, $P < 0.04$).

CONCLUSION: 1. The asymmetric quadhelix appliance improves the shape of an asymmetric dental arch in crossbite. 2. The presence of a prolonged arm touching the palatal surfaces of the anterior teeth does not result in their excessive protrusion.

42 INCREASE OF TEMPERATURE DURING COMPOSITE RESIN REMOVAL

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AIM: To measure the temperature of the tooth during mechanical composite resin removal with carbide burs.

MATERIALS AND METHOD: Sixty extracted human anterior teeth were typically prepared for bonding of resin on their buccal surface. An apicectomy approximately 4 mm incisal to the anatomic apex was then carried out with a diamond bur. Using root canal reamers, the lumen of the canal was widened up to Kerr 40. A probe was inserted and attached by a heat-conducting paste. For removal of the composite material three different burs were used (T6, T12 and T40 according to the number of threads on the shaft) under water cooled conditions. For each type 20 teeth were subjected to testing.

RESULTS: The mean values of the maximum temperature after 20 seconds of resin removal are shown below. The differences were compared with a baseline of 26°C .

Group	Temperature ($^\circ\text{C}$)	Difference ($^\circ$)	Standard Deviation ($^\circ$)
T6	35.4	9.35	6.5
T12	32.1	6.13	4.6
T40	27.0	1.01	2.9

CONCLUSION: T40 carbide burs under continuous water cooling caused the lowest elevation of intradental temperature. A rise in temperature of 1.1°C does not carry any risk to pulp health. Intermittent debonding is advisable. As the peak temperature occurs after 10 seconds the contact bur-to-tooth-surface should not last more than five seconds. T6 burs should not be used in clinical practice.

43 PERCEIVED NEED FOR ORTHOGNATHIC TREATMENT

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AIM: As orthognathic treatment has become more widely available and more socially acceptable, the demand for treatment has increased. The aim of treatment is not to create a theoretical ideal of beauty, but to correct the problem from the patient's

perspective. In an attempt to learn more about why patients feel they require orthognathic treatment, a questionnaire-based study was designed to examine their perceived need for treatment based on facial appearance, dental appearance, function and overall need.

SUBJECTS AND METHOD: Forty pre-orthognathic treatment patients were recruited from new patient clinics and marked their ratings for these four parameters on 10 cm visual analogue scales (VAS) anchored at each end. In addition, 20 orthodontists and 20 maxillofacial surgeons rated the perceived need for treatment for identical parameters, using study models and clinical photographs of the patients. Again, ratings were marked on 10 cm VAS scales anchored at each end.

RESULTS: Significant differences were found between patients and clinicians in terms of perceived need for treatment based on facial appearance (orthodontists $P = 0.023$, surgeons $P = 0.001$). The results also showed that maxillofacial surgeons rated treatment need based on facial appearance ($P = 0.005$) and anticipated functional problems ($P = < 0.001$) significantly higher than orthodontists.

CONCLUSION: Patients and clinicians do not always perceive the same need for treatment. In addition, it must be noted that marked variation existed within the clinician groups.

44 BILATERAL MASSETER MUSCLE THICKNESS IN GROWING INDIVIDUALS WITH UNILATERAL CROSSBITE

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AIM: To determine if there are bilateral differences in masseter muscle thickness in untreated individuals with lateral crossbites and following successful treatment of this malocclusion.

SUBJECTS AND METHOD: Three groups of growing individuals were examined: a) Untreated group: 38 individuals (17 males, 21 females) with unilateral crossbite, b) Control group: 224 subjects (112 males, 112 females) without transverse discrepancy and c) Treated group: 18 individuals (9 males, 9 females) with functional lateral crossbite, treated with only a Quad-helix appliance. The latter group were at least three years out of retention at an age where all permanent teeth, except the third molars, had erupted. The thickness of the masseter muscle was measured bilaterally with ultrasonography.

RESULTS: In the untreated group, the thickness of the masseter muscle on the crossbite side was significantly thinner than the contralateral side ($P = 0.025$). No statistically significant differences were found in the thickness of the masseter muscle between the left and right side in the control group. In the treated group, no statistically significant differences were found in the thickness of the masseter muscle between the former crossbite side and the normal one.

CONCLUSIONS: The treatment of the unilateral crossbite seems to eliminate the pre-treatment asymmetric masticatory muscle deficiency.

45 THE MORPHOLOGY OF THE SELLA TURCICA DEVIATES IN GENOTYPE VARIATIONS

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AIM: In cephalometry the sella point, s, is central for assessing the cranial base angle and the position of the jaws. In deviant morphology of the sella it can be difficult to identify point 's'. The present study aimed to analyse the aetiology behind different morphological deviations and their influence on the sella turcica. The presentation summarises 11 formerly published scientific papers.

MATERIALS AND METHOD: In connection with pre-natal autopsy, the sella turcica region was examined radiologically and histologically in 88 fetuses

(gestational ages 12-22 weeks) with genotype deviations. The morphology of the sella turcica region was compared with the radiographic appearance of the same region in 75 children with similar genotype deviations.

RESULTS: The pre- and post-natal comparison showed that morphological agreements existed in each genotype. The following characteristics in the morphology of sella turcica were observed in the following disorders: Trisomy 21: deviation in the frontal wall; Trisomy 18: deviation in the posterior wall; Fragile X: Large, wide, open sella turcica; Myelomeningocele: oblique anterior wall in sella; Hydrocephalus: extremely deviant morphology; a single solitary maxillary central incisor (associated with holoprosencephaly): small sella size and deviant anterior wall.

CONCLUSION: Deviations in the morphology of the sella turcica manifest themselves early in foetal life (from the gestational age of 14 weeks). More significant congenital deviations in the morphology of the sella turcica are associated with genotype deviations.

46 EARLY TREATMENT IN THE MIDDLE MIXED DENTITION FOR THE TREATMENT OF CROWDING AND CLASS II (*)**

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KEYNOTE ADDRESS

The question: In orthodontic education we devote much time and energy to the teaching of growth and development. Why then in practice do we tend to bypass the eruption process and wait until much eruption and growth have taken place before starting treatment?

‘Early treatment’ of crowding, Class II malocclusions, and increased overbite, has long been the subject of debate and controversy. Critics argue that early intervention creates lengthy treatment, has long transition times, necessitates a lengthy fixed appliance phase, and is more costly.

In relation to crowding, screening of dental pantomograms of children in the early mixed dentition indicates that in cases of crowding the developing permanent tooth buds exhibit more angulation and more non-parallelism *vis-à-vis* their primary counterparts. This results in uneven resorption of primary roots, over-retention of primary teeth and deflection during eruption with eventual crowding of permanent teeth once erupted. Both the crowding and the related ectopia can be prevented by the ‘redirection of eruption’ through extraction of primary teeth and maintenance of space with a lip bumper.

In the case of a Class II molar relationship it has been demonstrated that the majority are actually Class I when studied from the lingual aspect. Research shows that ‘mesial rotation of the maxillary first molars’ exists in 95 per cent of Class II subjects with crowding. This suggests that most Class II molar relationships have a mesial rotation of the molar rather than a mesial displacement leading to the Class II relationship. This makes derotation of maxillary first molars a primary objective of treatment. When treated early, the deep bite can be corrected by differential eruption.

Mechanics and therapeutic components: The combined use of flexible lip bumpers, a bite plane and sequential primary tooth extractions will be shown to accomplish the objectives of maxillary molar rotation, redirection of eruption, the resolution of crowding, and bite opening. Thus, total treatment time, transition time, and second phase treatment can be markedly reduced – the goal being a more biological and less mechanical treatment approach.

47 RELATIONSHIP BETWEEN OVERBITE AND VERTICAL SKELETAL PATTERN IN UNTREATED ADULTS

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AIM: Cephalometric studies relating overbite (OB) and skeletal pattern in treated and untreated subjects rely on angular or linear measurements. There is controversy as to which measurements are most suitable for this purpose. The aim of this study was to assess the vertical skeletal dimensions most related to OB.

SUBJECTS AND METHOD: Several cephalometric measurements were correlated to OB in (1) 557 untreated adults and (2) 220 longitudinally studied subjects at three time points: T1 (10.9 years), T2 (12.0 years) and T3 (26.3 years). In the untreated sample, short (SF), vertical normal (VN) and long (LF) face subgroups were defined based on anterior lower face height (ALFH). For the longitudinal sample, skeletal measurements at all three time points and changes during treatment were correlated with the post-retention OB.

RESULTS: For both samples, the OB correlated most strongly with the angle ANS-Go-Me. In the untreated adults, the correlation coefficients were -0.65 (total group), -0.41 (LF) and -0.54 (VN). For the longitudinal sample, the correlation coefficients were -0.42 (T1), -0.44 (T2) and -0.46 (T3). The correlation between OB and ALFH increased with time. The only pre-treatment predictor of the OB at T2 was ANS-Go-Me (multiple $R^2 = 0.36$). At T3 the pre-treatment predictors were ANS-Go-Me, overbite depth indicator (ODI), ALFH and PPGoMe (multiple $R^2 = 0.47$). The pre- and post-treatment predictors were ANS-Go-Me (T1), ODI (T1) and ALFH (T2) (multiple $R^2 = 0.46$).

CONCLUSIONS: The angle ANS-Go-Me shows the most constant correlation with OB through time, except for the SF group, where the ODI showed a larger correlation. The correlation with ALFH increases with time.

48 CEPHALOMETRIC AND DENTAL ANALYSIS OF CHILDREN WITH REPAIRED UNILATERAL CLEFT LIP AND PALATE

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AIM: To investigate treatment outcomes of three groups of children with unilateral cleft lip and palate (UCLP) treated by different surgical protocols. The quality of the outcome, with respect to craniofacial form and dental arch relationship, was compared with those reported in the Eurocleft study.

SUBJECTS AND METHOD: Sixty-two (20 females; 42 males) UCLP children consecutively treated at the Centre of Craniofacial Disorders (CCD), who had cephalometric and dental records taken between the ages of 9.5 to 10.5 years. The skeletal and soft tissue morphology was analysed according to Steiner, and dental arch relationship was measured with the Goslon Yardstick. The cephalometric and dental mean values were compared using the *t*-test for independent samples at the 95 per cent confidence level.

RESULTS: When comparing the cephalometric variables from the CCD with the Eurocleft centres no significant difference, except with one centre, was found for most of the variables. Eighty-eight per cent of the CCD group had an excellent to satisfactory dental arch relationship according to the Goslon Yardstick.

CONCLUSION: Early one-stage cleft surgery is valuable method in treating UCLP patients.

49 INTRA-ARTICULAR STEROID INJECTION IN THE TEMPOROMANDIBULAR JOINT IN EXPERIMENTALLY INDUCED ARTHRITIS

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AIM: Intra-articular (IA) steroid injections (SI) in joints other than the temporomandibular joint (TMJ) may preserve normal function by arresting the initial inflammation and probably diminish the destructive process in children with juvenile

idiopathic arthritis (JIA). The aim of this investigation was to evaluate the effect of IASI on experimentally induced TMJ arthritis in young rabbits by means of contrast enhanced magnetic resonance imaging (MRI) and histology.

MATERIALS AND METHOD: Arthritis was induced in the left TMJ with an IA injection of ovalbumin and Freund's adjuvant in 14 ten-week-old growing rabbits. Of these, six animals were left untreated (group A) and eight rabbits were treated with an IASI in the left joint 5 days later (group B). Six untreated rabbits were not antigen-challenged and served as the controls (group C). All joints were examined with contrast-enhanced MRI 7 to 10 days post-challenge and the enhancement curve was evaluated for each joint. Groups A and C were sacrificed immediately after the MRI and all joints were examined histologically.

RESULTS: The left antigen-challenged joint in group A showed significantly more inflammatory activity than the right joint both histologically and on MRI. The differences between the left and right joint in groups B and C were not significant. The left joints in group B showed less inflammation when compared with the left joint in group A and no difference with group C.

CONCLUSION: IASI in experimentally induced arthritic TMJs significantly inhibits the initial inflammatory response and may be considered in the treatment of TMJ involvement in JIA.

50 MAXIMUM RATE OF TOOTH MOVEMENT IN DOGS AND HUMANS

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AIM: To develop a mathematical model to describe the relationship between orthodontic forces and the rate of subsequent tooth movement.

MATERIALS AND METHOD: Data from two types of experiments were used: (1) studies in beagle dogs in which the mandibular second premolars were moved distally by forces ranging from 10 to 1200 cN, and (2) human studies in which canine retraction was performed using forces of up to 1500 cN. To develop the mathematical model, iterative non-linear regression techniques were used on the dog data, based on the following equation: $\text{Sqrt}V(F) = \text{sqrt}(V_{\text{max}}) * (F/F_{\text{max}})^{F_{\text{max}}/F_b} * e^{(F_{\text{max}}-F)/F_b}$. Subsequently the same techniques were used for analysis of the human data.

RESULTS: In dogs an optimal fit of this equation to the force-velocity data was obtained with the following parameters: $V_{\text{max}} = 0.27$ mm/week (95% CI 0.23-0.30), $F_{\text{max}} = 248$ cN, and F_b (a scaling parameter) = 2550 cN. The correlation coefficient between force and velocity was $r = 0.648$, so $r^2 = 0.42$, meaning that 42 per cent of the variability was explained by the force magnitude. In humans the following parameters led to an optimal fit: $V_{\text{max}} = 0.29$ mm/week (95% CI 0.26-0.33), $F_{\text{max}} = 272$ cN, and $F_b = 784$ cN.

CONCLUSION: This mathematical model shows that the maximum rates of experimental tooth movement in dogs and humans are very closely related. This suggests that biological processes, such as bone resorption and periodontal ligament turnover, responsible for orthodontic tooth movement have the same limitations in both species.

51 TISSUE ENGINEERING IN RELATION TO ORTHODONTIC TREATMENT

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KEYNOTE ADDRESS

Forces can modulate bone and cartilage growth. All force properties, including magnitude and duration, have been examined with the sole exception of frequency. Cyclic forces with sinusoidal waveforms not only accelerate growth of sutures, but also the sphenooccipital synchondrosis. The greater the frequency, the greater the anabolic responses, as exemplified by increasing bone and cartilage volume as well as

greater proliferation of sutural cells and chondrocytes. Forces also modulate gene expression in sutures and the sphenooccipital synchondrosis. It is likely that mechanical stresses accomplish their anabolic and/or catabolic effects on craniofacial tissues via regulation of genes. These findings may have clinical implications.

52 MASTICATORY MECHANICAL DEMANDS AND ALVEOLAR BONE STRUCTURAL ADAPTATION IN YOUNG GROWING RATS

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AIM: To investigate the effect of different masticatory functional and mechanical demands on the structural adaptation of the mandibular alveolar bone in the growing rat.

MATERIALS AND METHOD: Thirty-six male albino rats (4 weeks old) divided into two equal groups, and fed with either a standard hard diet or a soft diet. After 2 weeks, half of the animals in both groups had their upper molars fitted with a posterior bite block. The remaining animals served as a control. After another 4 weeks the animals were sacrificed and their left hemi-mandibles were excised. Bone mineral density (BMD) and bone microstructure parameters of the alveolar process were measured, using dual-energy X-ray absorptiometry and micro-computed tomography.

RESULTS: The bite block affected both the alveolar process height (decreased) and width (increased). It did not influence the BMD, but led to a significant increase of cortical thickness ($P < 0.01$). Soft food resulted in a reduction of BMD ($P < 0.05$) and an increase of trabecular bone volume fraction ($P < 0.05$) and thickness ($P < 0.01$).

CONCLUSIONS: Both experimental factors led to significant shape and structure modification of the mandibular alveolar bone in the growing rat. The bite block applied a continuous light force, which resulted in inhibition of vertical growth of the alveolar process and a significant increase of cortical thickness. A soft diet and the consequent reduction of the intermittent forces applied to the alveolar bone during mastication resulted in a reduction of BMD, trabecular bone volume and thickness.

53 OUTCOME OF UNILATERAL CLEFT LIP AND PALATE TREATMENT ASSESSED THROUGH THE INTERNET

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AIM: For intercentre studies on cleft lip and palate, or those that require ratings by external judges, the judges, the casts, or both, must travel to the place where the rating will be carried out. This is inevitably associated with some expense, inconvenience, and possible damage to the plaster casts. A more convenient approach would be to substitute the casts by photographs and undertake the rating through the Internet. The aim of this study was to investigate the reliability of using photographs of study casts as an alternative to plaster casts for rating dental arch relationships in unilateral cleft lip and palate (UCLP) subjects.

MATERIALS AND METHOD: Records of 49 consecutive patients with a complete UCLP were used. The dental casts, as well as their corresponding photographs, were scored independently by four observers, using the Goslon Yardstick rating system.

RESULTS: A high intra- and inter-observer agreement was found for the Goslon classification on dental casts as well as on their corresponding photographs. No significant differences were found between the rating of dental casts and photographs of dental casts.

CONCLUSIONS: Photographs of dental casts provide a consistent, reproducible method for rating dental arch relationships in patients with UCLP and provide a reliable alternative to the application of the Goslon Yardstick on dental casts. Thus,

for intercentre studies treatment outcome in UCLP can be more conveniently assessed using the possibilities of the Internet.

54 THE 'DIVINE PROPORTIONS' IN AN ATTRACTIVE FACE

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AIM: To assess to what extent 'divine proportions' exist in attractive and non-attractive faces.

MATERIALS AND METHOD: Facial photographs from two groups of subjects were analysed: group 1 comprised 50 female models portrayed on the covers of well-known fashion magazines and group 2, 29 females with an attractive face and 21 females with an unattractive face, as selected by a panel of 54 dental students from a group of 398 orthodontically treated patients. The photographs were analyzed with respect to divine facial proportions in both the transverse and vertical planes.

RESULTS: Divine facial proportions existed in approximately 20 per cent of the models and in 13 per cent of the attractive faces, but in none of the unattractive faces.

CONCLUSION: Divine facial proportions can explain facial attractiveness only to a limited extent. Facial beauty appears to be a subjective perception 'in the eyes of the beholder'.

55 CEPHALOMETRIC SOFT TISSUE AND INCISOR POSITION CHANGES FOLLOWING ADULT TREATMENT.

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AIM: To analyze cephalometric soft tissue changes related to changes in incisor position following treatment in adult patients.

SUBJECTS AND METHOD: Twenty-one adult patients (4 males, 17 females, mean age 25.9 years), treated with the segmented arch technique. The subjects were divided into Class II division 1 and Class II division 2, according to the upper incisor position as evaluated through incisor inclination on SNA-SNP, incisor inclination on NA and overjet. In 10 subjects the upper incisors had a buccal inclination (Group A) and in 11 patients a palatal inclination (Group B). Lateral cephalograms before and after treatment were traced and digitally measured by the same orthodontist. Data were analyzed with paired *t*-tests.

RESULTS: No changes in mandibular position occurred during treatment. The upper incisors were retracted and palatally inclined in group A, whilst only buccal inclination occurred in group B. The lower incisor position varied only in group B, due to buccal inclination. The overjet significantly decreased in group A, but in group B there were no significant changes. Overbite changes were not significant in either group. In group A, the upper lip followed the upper incisor retraction with a mean movement of 2 mm. Fewer changes occurred for the lower lip. No significant soft tissue changes could be detected in group B.

CONCLUSIONS: Orthodontic correction of upper incisor protrusion in adults has a positive effect on soft tissue aesthetics, while the buccal inclination of palatally inclined upper incisors appears to have little effect on lip position.

56 SUITABILITY OF THE MANDIBULAR ALVEOLAR PROCESS FOR ORTHODONTIC MICRO-IMPLANTS

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AIM: The stability of orthodontic micro-implants depends on the amount and quality of bone. The aim of this study was to investigate the suitability of the mandibular

alveolar process for the placement of micro-implants using dental computed tomography (CT).

MATERIALS AND METHOD: Fifty-one dental CTs of 51 patients who underwent the examination before osteotomy of the third molars (average age 24.0 ± 8.1 years). The total bone amount was assessed measuring the breadth of the alveolar process, the interradicular distances, and the thickness of the cortical bone layer at the crestal and apical level. Additionally the alveolar canal could be identified.

RESULTS: At the crestal level the average orovestibular diameter of the alveolar process was 5.1 ± 1.2 mm in the anterior region and increased to more than 15 mm between the second and third molars. The apical breadth of the alveolar process varied between 7.2 ± 0.9 mm (anterior) and 13.9 ± 2.3 mm between the second and third molar. Interradicular distances were generally below 2 mm at the crestal level and had a peak of 4.4 mm between the apices of the second and third molars. The largest distance was found between the premolars at the mental foramen. The average thickness of the cortical bone layer varied between 0.9 and 2.7 mm.

CONCLUSION: Quality and amount of bone seem to be generally sufficient for implant placement in the apical region distal from the second premolar. Contraindications are between both premolars due to the mental foramen. Exact radiographic examination should precede interradicular implants mesial from the canines.

57 CRANIOFACIAL MALFORMATIONS: PRINCIPLES AND MANAGEMENT.

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SHELDON FRIEL MEMORIAL LECTURE

In addition to improving appearance, function and psychology of patients with craniofacial malformations, established craniofacial teams have widened the scope and vision of the involved specialists. Every major surgical advance impinges unexpectedly on other branches of medicine and dentistry. The use of implants, bone transplantation and distraction osteogenesis have had a vast impact on the indications for treatment. Also a renewed dialogue with genetics, embryology and anatomy has taken place. Slavkin stated: 'Traditional concepts and methods now merge within a new intellectual and methodological synthesis in cellular, molecular and developmental biology'.

A WHO report in 2002 identified three interrelated research issues in relation to the care of patients with craniofacial malformations, evidence-based care, quality improvement, access and availability. Three other major themes are gene/environment interaction, genetics and prevention.

An understanding of normal craniofacial development is implicit to begin to comprehend changes that result in malformations. As shown by Björk, abnormal craniofacial development is a demonstration of the importance of certain growing areas in the head. Certainly a new classification of craniofacial malformations is needed because the adopted terminology used in syndromology has always been far from satisfactory. Some syndromes have ceased to exist as separate entities when more information is gained. The dualism between morphological and morphogenetic types of classification may be solved when the pure genetic description of the malformation can be given. The malformations most commonly found, such as of the mandible (hemifacial microsomia), and the upper face and cranial vault (craniosynostosis) will be presented. The use of two- and three-dimensional imaging in the process of diagnosis and in the evaluation of treatment outcome will be discussed.

Orthodontic correction in severe cases of malformation is often ineffective in the long term, but orthodontic treatment is important when applied to support surgical procedures. The protocols for the management of different malformations will be described and discussed in the light of the pressing need for a critical mass of clinical

research and sufficiently large samples of patients. There is an urgent need to create collaboration between craniofacial teams with a history of high volume and excellent care for children and patients with craniofacial malformations.

58 ROOT RESORPTION DURING ORTHODONTIC TOOTH MOVEMENT IN YOUNG AND ADULT RATS

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AIM: To evaluate root resorption during orthodontic tooth movement in young and adult rats.

MATERIALS AND METHOD: Standardised orthodontic tooth movement was performed in two age groups of 30 male rats. A split mouth design was chosen, with three maxillary molars on the experimental side moved as a single unit mesially with a Sentalloy coil spring delivering a constant force of 10 cN. The contralateral molars served as the controls. At 1, 2, 4, 8, and 12 weeks groups of animals were killed for histological evaluation. The study evaluated the effect of tooth movement on the first root of the first molar. Root resorption was measured as the resorbed root length at both pressure and tension sides. Differences between the experimental and control sides, and pressure and tension sides were calculated across time and were compared within and between the groups as measures for the effects of orthodontic force and age.

RESULTS: Root resorption at the experimental pressure side showed no difference between young and adult rats at 1, 2, 4 and 8 weeks. However, at 12 weeks it was significantly higher in adult than in young rats ($P < 0.05$), with adult rats demonstrating significantly higher levels of root resorption on the experimental pressure side than controls ($P < 0.01$). Root resorption at the experimental pressure and tension sides were highly correlated in both groups ($P < 0.01$). Orthodontic forces did not induce more root resorption in juveniles. Persistent orthodontic force tended to induce more resorption in adults.

CONCLUSION: Greater care in adults may be needed during tooth movement to prevent root resorption.

59 BIOLOGY OF AGEING AND ITS MODULATION

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KEYNOTE ADDRESS

Biological causes of ageing lie not in any specific gerontogenes, but in a progressive failure of maintenance and repair. There is sufficient evidence to show that the lifespan of species is positively correlated with maintenance and repair pathways, such as DNA repair, antioxidant levels and responsiveness to stress. Therefore, the focus of 'anti-ageing' research has now shifted to finding ways of slowing down and preventing the failure of maintenance. A promising approach is rooted in making use of the homeodynamic property of self-maintenance in the living systems. It has been hypothesised that if cells and organisms are exposed to brief periods of stress so that their stress response-induced gene expression of repair pathways are upregulated, then anti-ageing effects can be observed. Such a phenomenon in which stimulatory responses to low doses of otherwise harmful conditions can improve the functional ability of cells is known as 'hormesis'.

Low level stresses that have been shown to slow down ageing include temperature shock, irradiation, heavy metals, pro-oxidants, acetaldehyde, alcohols, hypergravity, exercise and calorie restriction. At the molecular level, the heat shock response is a highly conserved primordial stress response essential for the survival of the cells. In a

series of experimental studies it has been shown that repetitive mild heat stress has anti-ageing effects on growth and various other cellular and biochemical characteristics of human skin fibroblasts. The hormetic effects of a repeated challenge at the levels of maintenance of stress protein profile, reduction in the accumulation of damaged proteins, stimulation of the proteasomal machinery of protein degradation, and maintenance of differentiated cell functions during cellular ageing are being characterized. The aim is to develop this strategy of hormetic challenge as a method to improve and maintain the biochemical and physiological performance of cells, tissues, organs and organisms for achieving a healthy old age.

60 INFLUENCE OF UNILATERAL CROSSBITE IN ASYMMETRIC MANDIBULAR DEVELOPMENT

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AIM: Mandibular asymmetry might be congenital, or caused by pathology, trauma, infections, muscular dysfunctions and problems caused by malocclusions. The main objective of this study was to evaluate the influence of unilateral crossbites in mandibular asymmetry, by means of oblique radiography at 45 degrees.

MATERIALS AND METHOD: The sample was selected from the longitudinal archive of the Burlington Growth Center and comprised the articulated upper and lower plaster models, frontal radiographs (to confirm the medium line deviation registered on the plaster model), and right and left oblique lateral radiographs, of a group of 22 individuals aged 6, 9 and 20 years. These individuals were divided into a control group (12 subjects, who never showed a crossbite at 6 years of age and remained that way until 20 years) and an experimental group (10 individuals with a unilateral crossbite from 6 to 20 years of age). On the oblique radiographs the condylar and symphyseal points were identified for measurement of right and left mandibular lengths. The asymmetric values were demonstrated by the difference in length.

RESULTS: Following statistical analysis, it was concluded that a unilateral crossbite, when untreated, develops into morphological mandibular asymmetry.

61 BITE FORCE IN RELATION TO OCCLUSION, CRANIOFACIAL DIMENSIONS AND HEAD POSTURE

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AIM: To examine bite force in relation to occlusion, craniofacial dimensions and head posture.

SUBJECTS AND METHOD: Eighty-eight children (48 females, 40 males aged 7-13 years), sequentially admitted for orthodontic treatment of malocclusions entailing health risks. Bite force was measured by means of a pressure transducer. Angle classification, number of teeth and contact were recorded and dental arch widths were measured on plaster casts. Craniofacial dimensions and head posture were recorded from lateral cephalometric radiographs taken in a standardized head posture (mirror position). Associations were assessed by Spearman correlations and multiple stepwise regression analyses.

RESULTS: The maximum bite force increased significantly with age in girls, with teeth in occlusal contact in boys, and with an increasing number of erupted teeth in both sexes. Bite force did not vary significantly between the Angle malocclusion types. Only in boys was there a clear correlation between bite force and craniofacial morphology: cranial base length (n-ba, n-ar), posterior face height (s-tgo, ar-tgo), vertical jaw relationship (NL-ML), mandibular inclination (NSL-ML), form (ML-RL) and length (pg-tgo) and inclination of the lower incisors (Ili-ML). Multiple regression analysis showed that the vertical jaw relationship ($P < 0.001$) and number of teeth present ($P < 0.01$) were the most important factors for the magnitude of bite force in

boys. In girls the most important factor was number of teeth present ($P < 0.001$). No correlations between bite force and head posture were found.

62 SHEAR BOND STRENGTH WITH A HIGH-POWER HALOGEN LIGHT-CURING SOURCE

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AIM: Orthodontic brackets are routinely bonded with light curing adhesives. For conventional halogen and light emitting diode (LED) lights the disadvantage is the long curing time of up to 40 seconds, and for laser and plasma lights, their cost. The aim of this study was to evaluate a relatively low-cost high-power halogen lamp for minimal curing time necessary to achieve bond strength as high as with a fast halogen and a plasma lamp.

MATERIALS AND METHOD: Five groups of 15 primary bovine incisors were bonded with stainless steel brackets (SS; Transbond) using different lights and curing times: groups 1, 2, and 3 with a high-power halogen light (Swiss Master Light) for 2, 3 and 2×3 seconds; group 4 with a fast halogen light (Optilux 501) for 2×20 seconds and group 5 with a plasma light (Remecure) for 2×2 seconds. The teeth were fixed in acrylic and stored for 24 hours at 37°C in water. Shear bond strength was measured with an Instron machine. Statistical evaluation was carried out using SPSS with a significance level of $P < 0.05$.

RESULTS: Only the curing time of 2 seconds with the high-power halogen lamp negatively affected bond strength and probability of bond failure. The adhesive remnant index was not significantly different between the groups. The majority of failures (>60 per cent) occurred in the bracket base/adhesive interface.

CONCLUSIONS: The high-power halogen lamp seems to be a cost-effective solution to reduce curing time. A time of 2×3 seconds is recommended for bonding SS brackets, and provided care is taken even 1×3 seconds. The clinical relevance of these findings has to be confirmed *in vivo*.

63 MAXILLARY DISTRACTION OSTEOGENESIS IN YOUNG PATIENTS: LONG-TERM FOLLOW-UP

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AIM: To evaluate the long-term stability of maxillary distraction osteogenesis (DO) and identify those patients with less stable results.

SUBJECTS AND METHOD: Fifteen patients [13 with complete unilateral (UCLP) or bilateral (BCLP) cleft lip and palate] treated by maxillary DO using a halo frame. The patient's median age was 11.7 years (range 8.3-16.5 years). The protocol used was: 5 days latency, 1 mm per day activation and 90 days consolidation. Long-term stability was analyzed by superimposition on the pre-operative lateral cephalogram, and relapse was estimated using multivariate regression analyses. The mean follow-up period was 24.3 months.

RESULT: At follow-up, SNA decreased progressively in all patients, however the final position of the maxilla was still significantly different from the pre-DO situation. Multivariate regression analyses, after 12 months showed that the risk factors for relapse are an initial maxillary advancement >7 mm and a UCLP, or particularly a BCLP. The estimated relapse after 12 months for a non-cleft patient was 1.7 mm, for a UCLP patient 2.7 mm, and for a BCLP patient 4.5 mm.

CONCLUSION: In children with severe hypoplasia, maxillary DO could be included in the treatment plan and possible relapse taken into consideration. Thus DO could be the first step of skeletal surgery in order to improve aesthetics and the psychosocial integration of the child and facilitate further orthodontic or orthognathic surgery.

64 EFFECT OF CERVICAL HEADGEAR WEAR ON DYNAMIC MEASUREMENT OF HEAD POSITION

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AIM: Cervical headgear (CHG) therapy causes alterations in the position of the mandible. However, the mechanism is unclear. A possible explanation is its effect on head posture. The aims of this study were to identify the effect of CHG wear on dynamic measurement of head posture during walking.

SUBJECTS AND METHOD: In 16 patients (11.9 ± 1.9 years) who were receiving CHG therapy, dynamic head posture was recorded using an inclinometer and data logger apparatus during a walking session of 5 minutes. This procedure was repeated before (T1) and after (T2) insertion of the CHG. The T1 and T2 measurements were repeated twice at 30 minutes intervals. The mean dynamic head posture was calculated for each subject and the collected data were statistically analysed with a *t*-test.

RESULTS: Fourteen subjects (87.5%) showed a cranial flexion with CHG wear in relation to T1 (1.4 to 8.9 degrees). The other two subjects (12.5%) showed a cranial extension of 1.6 and 3.8 degrees. The mean values of T1, T2 and T1-T2 were 1.4, -1.8, and 3.1 degrees, respectively, which indicated a mean cranial flexion. According to the paired samples *t*-test, there were statistically significant differences between the two different measurements of dynamic head posture measurements recorded before and after CHG application ($P < 0.001$).

CONCLUSION: CHG wear causes significant cranial flexion, which may account for its effects on the position of the mandible.

65 MICRODAMAGE IN THE ALVEOLAR BONE FOLLOWING ORTHODONTIC TOOTH MOVEMENT

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AIM: Microcracks and microdamage have been associated with bone remodelling. The aim of this study was to investigate the role of microcracks as a trigger for alveolar bone remodelling after application of an orthodontic load.

MATERIALS AND METHOD: In 25, 3-month-old male Danish land-race pigs the lower right first molar was moved buccally with a force of 150 cN. The contralateral molar was left untreated and served as the control. After 1, 2, 4, 7 and 15 days of treatment the regions containing the right and left molars were excised and en bloc stained in basic fuchsin. The presence of microcracks on the buccal and lingual sides of both treated and untreated teeth was detected and expressed as crack density (number per mm²).

RESULTS: The buccal surface on the treatment side showed significantly more cracks at day 1, compared with the control. This difference was significantly larger than observed at days 2, 7 and 15. The buccal surface of the treated molar also demonstrated significantly more microcracks than the lingual aspect at day 1, and this difference was larger compared with that observed on days 4 and 15.

CONCLUSION: The presence of microcracks associated with teeth being moved suggests they may have a role to play in the initiation of bone remodelling, following orthodontic loading. Furthermore, their localization to the side towards which tooth movement is taking place suggests that microcracks could represent the first damage induced by orthodontic force that has to be repaired.

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66 CYTOKERATINS IN THE PALATAL MUCOSA OF CLEFT PALATE PATIENTS

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AIM: The surgical closure of a palatal cleft is complicated by a shortage of mucosal tissue. This problem may be solved by the development of tissue engineered substitutes with autologous cells. The aims of the present investigation were to characterize the different types of epithelium in the region of the palatal cleft.

SUBJECTS AND METHOD: Patients with a non-syndromic palatal cleft (1-2 years of age) were selected. During surgery, samples from the hard palatal mucosa were obtained with a 3-mm biopsy punch and from the cleft region by excision. Sections were stained with haematoxylin and eosin for a general tissue survey. Immunostaining was performed for the following antigens: cytokeratins (CK) 7, 8, 10, 16 and 18, and the basal membrane markers, heparin sulphate (HS) and collagen type IV (COL IV).

RESULTS: The epithelium of the mucoperiosteum of the hard palate was orthokeratinized, multilayered and stratified (CK10+, 16+). The soft palatal mucosa at the margin of the cleft resembled both oral and nasal mucosa. At the oral side a non-keratinized epithelium was found (CK4+, CK13+). At the nasal side fewer cell layers were present and the keratinocytes were more ovoid (CK7+, CK8+, CK18+). Higher numbers of inflammatory cells were also present and a lower expression of HS and COL IV was found in the basal membrane.

CONCLUSIONS: The margin of the cleft presents a unique type of epithelium showing a clear transition from an oral type to a more nasal type. The specific properties of the marginal epithelium may underlie the impaired fusion of the palate.

67 THE RELATIONSHIP BETWEEN THE HARD AND SOFT TISSUES OF THE FACE

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KEYNOTE ADDRESS

The skull is the basic armature for the face and directly influences the facial proportions, the muscle structure, the feature formation, and, hence, the detailed facial appearance. Each face is unique and we are each capable of perceiving very subtle differences between faces in order to carry out personal recognition.

Following an anatomical method it is possible to sculpt the face of an individual onto the detailed armature of the skull. This method has been developed at the University of Manchester over the last 25 years for forensic identification. Since faces are fascinating, faces from the past hold a particular fascination.

The reconstruction method has also been used to 'bring to life' the faces of numerous individuals from archaeological burials, which include Egyptian mummies, bog bodies and British historical battle victims.

68 EVALUATION OF MyHC-mRNA IN THE MASSETER BY REAL-TIME-POLYMERISED CHAIN REACTION IN PATIENTS WITH MAXILLOFACIAL SURGERY

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AIM: Orthodontic and surgical treatment leads to muscle stress and polymorphic expression of myosin heavy chains (MyHC). The aim of this study was to examine the suitability of real-time-polymerised chain reaction (PCR) for MyHC-mRNA quantification and to examine the effects of treatment on the resistance to fatigue of masticatory muscles.

SUBJECTS AND METHOD: Thirty adult patients (15 Class II and 15 Class III) who had undergone maxillofacial surgery were examined. Muscle biopsies were obtained from the anterior and posterior regions of the right and left side of the masseter muscle prior to and 6 months after surgery. mRNA analysis was performed by real-time-PCR to quantify MyHC-mRNA isoforms I, IIa and IIx/d in muscle fibres.

RESULTS: Treatment of a Class II malocclusion led to a significant decrease ($P < 0.01$) in type I, IIa and IIx/d MyHC-mRNA levels in the anterior part of the masseter. A decrease of mRNA in the anterior part was combined with a lower decrease in the posterior part. Treatment of a Class III malocclusion led only to a decrease of mRNA in the posterior part of the masseter (type I $P < 0.01$, type IIa $P < 0.05$ and type IIx/d $P < 0.05$). Combined orthodontic and surgical treatment showed good occlusal stability but led to a large muscle atrophy or better use of muscle power.

CONCLUSION: Real-time-PCR is a suitable method to reduce biopsy size for quantification of MyHC-mRNA levels to investigate the functional status of masticatory muscles.

69 NATURAL HEAD POSTURE FOR MEASURING THREE-DIMENSIONAL SOFT TISSUE MORPHOLOGY

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AIM: To evaluate the reliability of natural head posture (NHP) in measuring three-dimensional (3D) soft tissue facial morphology.

SUBJECTS AND METHOD: Forty subjects, mean age 11.3 years, enrolled in the craniofacial growth study programme at the University of Wales College of Medicine. Laser-scanned images were obtained with two Minolta Vivid 900 laser-scanners. A set of left and right scanned images of the same subject was taken on two separate occasions, 3 days apart. The two scanned images were processed and merged to form a composite 3D soft tissue reproduction of the subject using Rapidform 2004. The following measurements were determined and analysed: shell deviations of two scans at time 1 (T1) and time 2 (T2) and the mean differences of the merged images at T1 and T2.

RESULTS: Two hundred and forty laser-scanned images were analysed. The mean shell deviations between the left and right scan for each subject were 0.38 ± 0.14 mm for scans at T1 and 0.34 ± 0.12 mm for scans at T2. Paired *t*-tests of the shell deviations of each subject revealed the mean difference was 0.04 ± 0.17 mm, indicating no significant difference between the same subject on the two occasions ($P > 0.05$). The mean difference of the merged composite faces of the subjects between T1 and T2 was 0.40 ± 0.11 mm. Aligned facial maps of the merged scans showed that 90 per cent of the created composite facial scans correlated to one another with an error up to 0.85 mm, which is clinically acceptable.

CONCLUSION: NHP is a clinically reliable and reproducible position for measurement of 3D soft tissue morphology in children.