

ABSTRACTS

OF LECTURES

(Poster presentations will appear in the October issue of the Journal)

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1 EVALUATION OF MAXIMUM BITE FORCE AND ANTERIOR COMPONENT OF OCCLUSAL FORCE IN SUBJECTS WITH DIFFERENT SAGITTAL AND VERTICAL SKELETAL RELATIONSHIPS

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AIMS: To determine the potential relationships between various sagittal and vertical skeletal patterns and maximum bite force, whether a relationship exists between the anterior component of occlusal force (ACF) and different sagittal and vertical skeletal relationships, and the possible relationship between ACF and dental malalignment.

SUBJECTS AND METHOD: Sixty-nine subjects (45 females, 24 males) whose ages ranged between 16 and 22 years. Maximum bite force was measured using a bite force transducer placed between the upper and lower first molars. ACF was measured at both the right and left sides of the upper and the lower dentitions, at 6–5 and 4–3 contacts. ACF was determined by measuring interdental frictional forces when biting and not biting. The subjects were classified according to their sagittal and vertical facial patterns, and also to the level of their dental malalignment.

RESULTS: Although not statistically significant, maximum bite force values in subjects with a Class I skeletal relationship were found to be higher than in Class II and Class III subjects. As expected, subjects with a low angle skeletal pattern had higher bite force values compared with normal and high angle subjects. Non-biting interproximal force values at 6–5 and 4–3 contacts were found to be higher in the group with severe crowding compared with the minimal ($P = 0.016$) and moderate ($P = 0.002$) crowded groups. No significant differences were found when the ACF values were evaluated according to the sagittal and vertical facial patterns. When evaluated according to crowding of the teeth, the ACF in the lower 6–5 contact was significantly higher in the group with moderate crowding, than in the one with minimal crowding.

CONCLUSION: ACF and contact tightness are related to lower anterior crowding. In order to be able to clearly distinguish the differences in maximum bite force according to different sagittal and vertical skeletal patterns, further studies are required.

2 LONG-TERM PROGNOSIS OF PATIENTS PRESENTING WITH AN OPEN BITE MALOCCLUSION

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KEYNOTE ADDRESS

An open bite may be defined as (1) lack of incisor contact measured along the long axis of the mandibular incisors as the distance from the mandibular incisal edge to the point of hard tissue contact in the maxilla, or (2) lack of incisor overlap measured as the vertical distance between the maxillary and mandibular incisal edges. Inferences from clinical studies suggest that about 40 per cent of patients presenting with more than a 3 mm open bite according to definition 1 will lose incisor contact following orthodontic treatment and retention. However, the loss of incisor contact is due to relapse of overjet rather than overbite. Few patients experience relapse according to definition 2. The pattern of relapse is similar in patients who have experienced combined orthodontic and surgical correction with maxillary impaction to reduce the lower face height concomitant with open bite correction. A recent study also suggests that pre-surgical incisor extrusion in such patients during levelling is stable long-term. Any reduction in incisor overlap may be more associated with molar extrusion into the increased freeway space after maxillary impaction. For that reason, mandibular osteotomy with counter-clockwise rotation of the distal segment may be a better

surgical option for skeletal open bite correction in patients without vertical maxillary excess.

3 PULPAL AND PERIODONTAL CONDITION OF AUTOTRANSPLANTED IMMATURE THIRD MOLARS AFTER ORTHODONTIC TREATMENT

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AIM: To determine the influence of orthodontic treatment on the pulpal and periodontal condition of 91 transplanted immature third molars. In cases of atrophy of the alveolar process or of unfavourable root morphology, transplants had to be placed in extreme rotated or infraoccluded positions. After 3 to 6 months, these transplants were derotated (45–90°) to a correct position in the dental arch ('derotation' group; $n = 28$), or were extruded to the occlusal plane ('extrusion' group; $n = 21$). Finally approximal spaces were closed in both groups. A sample of 42 transplanted third molars with no orthodontic treatment need served as the control group. All transplants were followed clinically and radiologically for a mean period of 4.0 years.

RESULTS: With respect to pulpal and periodontal conditions, no significant differences were observed between the control and extrusion group, or between the extrusion and derotation groups. In contrast, compared with the control group, transplants in the derotation group revealed a significantly poorer pulpal ($P = 0.002$) and periodontal ($P = 0.005$) condition. For the derotated transplants a significant correlation was detected between pulp necrosis and orthodontic treatment of multirooted transplants.

CONCLUSION: Orthodontic extrusion and minor lateral movement of autotransplanted immature third molars represents no additional risk to transplant survival. However, rotation seems to initiate later severance of the vascular and neural supply to the pulp, especially in multirooted transplants.

4 SUCCESS RATE AND DURATION OF ORTHODONTIC TREATMENT FOR ADULT PATIENTS WITH PALATALLY IMPACTED MAXILLARY CANINES

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AIM: To examine the success rate and length of orthodontic treatment of impacted maxillary canine teeth in adult patients.

SUBJECTS AND METHOD: Nineteen adult patients (mean age 28.8 ± 8.6 , range 20–47 years), who had been treated for a total of 23 impacted maxillary canines, were compared with a control group of young individuals (mean age 13.7 ± 1.3 , range 12–16 years). The control individuals were chosen for a similar degree of impaction difficulty, by careful matching of the position of the impacted canines, in the three planes of space.

RESULTS: The success rate among the adults was 69.5 per cent, compared with 100 per cent among the controls. The lower success rate was due to five canines that had failed to erupt and two that had been partially extruded but could not be fully aligned in the arch. The duration of treatment of the overall malocclusion of the adult and young cases did not differ materially. However, the adult subjects showed significant increases in the duration and number of treatment visits required for resolving the canine impaction, in both the simpler and the more difficult cases. When further divided by age, all the failed canines were found in the older (over 30) adult sub-group.

CONCLUSIONS: The prognosis for the success of the orthodontic resolution of an impacted canine in an adult is lower than in the young patient and that it worsens with age. Furthermore, when such

treatment is undertaken, its successful completion should be expected to take considerably longer.

5 A NEW POSITION IN THE PALATE FOR ORTHODONTIC IMPLANTS—A CLINICAL STUDY

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AIM: To find an alternative palatal implant site which offers a higher amount of bone support and also a high success rate for temporary implants.

SUBJECTS AND METHODS: Twenty-one patients (aged 14.1 to 49.3 years) were included in this prospective study for orthodontic treatment in the maxilla. Depending on the pre-surgical diagnostic evaluation by means of low-dose dental computed tomography, either 3 or 4 mm implants (flange fixture, Nobel Biocare®, Sweden) were inserted paramedially avoiding the mid-palatal suture. After healing, the implants were loaded to achieve maximal anchorage, and removed after orthodontic therapy.

RESULTS: In 50 per cent of the patients the local bone quality was Class 3 according to Lekholm and Zarb (1985). In nine subjects a screw tap was needed. The maximum torque for insertion ranged between 20 to 45 Ncm without a statistical correlation with local bone quality. All implants were primarily stable. After an unloaded healing period of 4.2 months (SD 1.6) a second stage procedure was performed installing a special orthodontic abutment with a defined torque of 10 Ncm. Five weeks after loading one implant became mobile and was lost due to the heavy smoking habit of that patient. Twenty-one implants have been under orthodontic loading for a period of 10.2 months (SD 3.5) without any peri-implant reaction and mobility. Two implants were removed because the orthodontic therapy has been successfully concluded.

CONCLUSIONS: The paramedian region in the palate appears to be an excellent implant insertion site offering adequate bone volume, good surgical overview and good hygienic conditions. Temporary implants will be of increasing importance in orthodontics due to the possibility of shortening the time of therapy and avoiding extraoral anchorage aids.

6 OVERBITE AND INTRA-ORAL MANDIBULAR DISTRACTION OSTEOGENESIS

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AIM: To evaluate the overbite of Angle Class II patients, before and after treatment with orthodontic appliances and mandibular intra-oral distraction osteogenesis.

SUBJECTS AND METHOD: Twenty-six patients with an Angle Class II malocclusion before treatment. Two lateral cephalograms, before distraction (T0) and at least one year after treatment (T1) were analysed. The same orthodontist and maxillofacial surgeon treated the patients. All patients were operated on consecutively. Their mean age at the time of distraction was 14.6 years and at final registration 17.3 years.

RESULTS: The increase in the value of the Y-axis and SN/MP angle before and after treatment was not statistically significant. The overbite decreased and SpP/MP value increased significantly. The use of the 'floating bone' technique in five of the patients did not permanently correct the overbite.

CONCLUSIONS: A decrease in overbite with this type of treatment can be expected. Orthodontic treatment and mandibular distraction should not be undertaken for patients with an open bite or a large SpP/MP angle.

7 TEMPOROMANDIBULAR JOINT FINDINGS DURING ORTHODONTIC TREATMENT ASSESSED BY MANUAL FUNCTIONAL ANALYSIS

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AIM: Recent studies have shown that approximately 25 per cent of young orthodontic patients present compensated temporomandibular joint (TMJ) disorders prior to orthodontic treatment. In patients with Angle Class II division 2 this percentage is even higher (>40%). The aim of this study was to investigate the changes in these findings over time without (control) and with orthodontic treatment.

SUBJECTS AND METHOD: The control group consisted of 200 patients (109 females, 91 males). Their mean age was 9.69 years. In the treatment group there were also 109 females and 91 males with a mean age of 10.54 years. The condition of the TMJ, soft tissues and the masticatory musculature was assessed by means of manual functional analysis (active movements, orthopaedic joint loading tests and isometric contractions). The clinical findings were rated as 'no pain' (physiological), 'provocable, unknown pain' (compensated disorders) and 'provocable, well known pain' (decompensated disorders). The examination was performed prior to orthodontic treatment and 3, 6, 9 and 12 months later for both groups. The patients in the treatment group were treated with modified activators (66%), Fränkel III appliances (21.5%) and fixed appliances (12.5%).

RESULTS: The percentage of patients free of symptoms decreased in the control group within 12 months from 80 to 68 per cent, whereas in the treatment group the percentage of painless patients increased from 60 to 91 per cent. The results were very similar for the different appliances.

CONCLUSION: The results of this controlled prospective study demonstrate the advantageous orthodontic treatment effects on pre-existing TMJ findings over a period of 12 months.

8 THE PREVALENCE OF BACTERAEMIA ON REMOVAL OF FIXED ORTHODONTIC APPLIANCES

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AIM: To investigate the prevalence of bacteraemia on removal of fixed appliances.

SUBJECTS AND METHODS: Venous blood samples were taken before and after debanding for 30 patients (mean age 17 years 8 months) who had worn fixed appliances for an average of 19 months (range 12 to 31 months). Immediately before the fixed appliances were removed plaque scores were recorded using the Bonded Bracket Index (Kilicoglu *et al.*, 1997) and the gingival condition was assessed using the Modified Gingival Index (Løe and Silness, 1963). The pre- and post-operative blood samples were cultured by the following methods: (i) Pour plate method using 20 ml of fastidious anaerobic agar (Lab M Ltd, Salford, Lancashire, England) supplemented with 5 per cent calf serum (Flow Lab Ltd, Harefield, England) to give a quantitative count of bacteria, (ii) Bac T/Alert system (Organon Teknika Corp., Durham, North Carolina), to provide a qualitative aerobic and anaerobic count based on a colorimetric detection system. Colonies from the pour plate were counted, subcultured and all those colonies that conformed to the genus streptococci were speciated.

RESULTS: Microbiological tests detected a bacteraemia in one patient (3 per cent) before the fixed appliances were removed and in four patients (13 per cent) following removal of their fixed appliances. The 95 per cent confidence intervals for the prevalence of the post-deband bacteraemia were 3.8 and 30.7 per cent. No significant relationship was

found between the mean plaque scores ($t = -0.65$, $P = 0.52$) and the mean gingival scores ($t = 0.75$, $P = 0.46$) and the occurrence of bacteraemia.

CONCLUSIONS: The prevalence of bacteraemia detected following debanding in this study is considerably lower than that reported for the dental procedures traditionally covered by antibiotic prophylaxis guidelines.

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9 BIOLOGICAL RESPONSES OF PERIODONTAL CELLS TO NANOPATTERNED SURFACES AND MECHANICAL FORCES

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AIM: Integrin receptors play an important role in (i) cell adhesion, (ii) signalling, and (iii) stress response. The purpose of this study was to investigate the role of bioactive surfaces and mechanical forces on cell functions, such as adhesion and formation of focal contacts. In addition, stress-associated expression of integrins in conjunction with focal adhesion kinase (FAK), and apoptosis were analyzed.

MATERIALS AND METHODS: Integrin ligand-carrying silicone membranes, grafted with RGD peptides arranged in highly defined patterns were used. Nanometer-sized adhesive dots, functionalized with cyclic-RGD peptides, were positioned on surfaces at different spacing (between 28 and 85 nm). Using these templates the dynamics of cell adhesion and the expression of integrin receptors, FAK and apoptosis was studied. Fibroblasts and osteoblasts were plated on surfaces with cyclic-RGD peptides and compared with strained cultures at different time points.

RESULTS: The covalent link of the RGD peptide to the surface profoundly enhanced the adhesion mediated by integrin receptors to the surfaces and the organization of the focal contact was dependent on the type of pattern used. After exposure to strain the expression of integrins and FAK was increased when compared with non-loaded controls. Furthermore, adhesion plaques were re-distributed on the cell surface. Also, stretched cells exhibited a higher resistance to apoptosis and increased activity of the Akt-dependent survival pathway.

CONCLUSIONS: These findings may contribute to the design of bioactive materials and to the study of the biological mechanisms of tooth movement. RGD peptides can be used to regulate local cellular responses, such as bone mineralization of osteoid tissue formed during orthodontic tooth movement. Moreover, this well-defined system designed for the application of mechanical forces to osteoblasts and fibroblasts is useful to understand specific responses at the resorption and apposition sites caused by orthodontic forces.

10 EXPLORING THE THIRD DIMENSION IN ROOT RESORPTION

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AIM: Root resorption has been a long studied phenomenon in orthodontics. Not until recently were we capable of exploring the extent of root resorption craters in three dimensions. The aim of this study was to determine the level of accuracy of various two-dimensional (2D) analyses of resorption craters.

MATERIALS AND METHOD: Are three-dimensional (3D) measurements necessary? Previous findings have demonstrated that accurate 3D volumetric measurements of resorption craters can be

obtained. Greater amounts of root resorption have also been shown to occur with greater levels of orthodontic forces (225 versus 25 g) as demonstrated in a sample of 36 premolars obtained from a human model ($P = 0.000$) for a 4-week experimental duration. A mathematical analysis of the 2D/3D relationship enabled determination of an appropriate digital model for the shape, type and dimensions of resorption craters and also to distinguish between a 'hemisphere' model versus a 'layer' model of craters.

RESULTS: 2D measurements were strongly correlated with 3D measurements ($r = 0.991^{**}$). Within the light and heavy force groups, the measurements were also strongly correlated ($r = 0.978^{**}$ and $r = 0.994^{**}$, respectively). In a 4-week experimental period, 2D measurements of root resorption craters were as reliable as 3D measurements if they are conducted adequately.

11 TONGUE THRUST: OCCLUSAL CHANGES AFTER SPEECH THERAPY

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AIM: To evaluate the effect of speech therapy on occlusion in tongue thrusters.

SUBJECTS AND METHOD: Fourteen tongue thrusters (mean age 10.5 years) were analysed after speech therapy according to Garliner. Cephalograms and dental casts were measured. No orthodontic treatment was performed. The length of speech therapy was 18 months.

RESULTS: The following changes were observed: a clockwise rotation of the maxillary plane ($P = 0.014$) with an increase of posterior vertical height; a clockwise rotation of the maxillary plane, determining a decrease in anterior face height and an increase in overbite ($P = 0.0013$); a significant increase in overbite with a deepening of the bite and/or closure of an open bite ($P = 0.026$); an increase in lower incisor alveolar height related to the more posterior positioning of the tongue ($P = 0.002$); an increase in upper and lower molar alveolar height. Upper anterior face height increased more than lower anterior face height, but not significantly ($P = 0.102$). No substantial modifications of upper and lower incisor inclination occurred, possibly because the myofunctional exercises involved the tongue more than the perioral musculature. No modifications of intermolar and intercanine diameters were observed.

CONCLUSION: Correction of function can and does result in significant skeletal modifications, improving the growth pattern. Thus, co-operation between orthodontists and speech therapists is advocated, with speech therapy in tongue thrusters and those with swallowing anomalies becoming an integral part of orthodontic treatment.

12 SYNCHRONOUS STRAIGHT-WIRE

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AIM: To assess the efficacy of the synchronous straight-wire technique in shortening treatment time clinically and chronologically. This technique aims to synchronise all aspects of treatment rather than sequence treatment events and thus improve treatment efficiency.

MATERIAL AND METHOD: Twenty patients were selected at random from cases treated at the Royal Hampshire County Hospital using the above technique. The parameters measured were Peer Assessment Rating (PAR) scores before and after treatment, number of visits taken for treatment and overall treatment time.

RESULTS:

Initial par score	44.5
Final PAR score	5.5

Reduction	39.0
Percentage reduction	88
Treatment visits	13.5
Chairside time (hours)	2.83
Treatment time (weeks)	66.25

CONCLUSIONS: Using comparable data for patients treated with the standard straight-wire technique, the results suggest that significant improvements can be achieved in terms of treatment time (clinical and chronological) and number of visits when comparing synchronous straight-wire with the conventional straight wire technique.

13 EVALUATION OF ORAL TISSUE THICKNESS FOR THE INSERTION OF ORTHODONTIC IMPLANTS

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AIM: To investigate the thickness of bone and soft tissue in the anatomical sites used for insertion of implants for orthodontic anchorage and to determine the best possible dimension of these devices.

MATERIALS AND METHOD: Group A contained 20 adult cadavers and group B 20 adult dry skulls. Six areas in the maxilla and six in the mandible were investigated. The soft tissues thickness was evaluated by piercing the cadavers with a stinging probe in the gingiva and in the mucous membrane. Bone thickness was established by cutting and drilling out the drill points in the dry skulls, and radiographic analysis. The bone tissue was analysed in the cortical lining and in the space between the bone surface from the dental roots and vascular-nervous foramens.

RESULTS: In the maxilla the thickest bone areas were found under the anterior nasal spine, in the apical area of the mesial root of the first molar, near to the mid-palatal suture, and in the retromolar tuberosity. Regarding the soft tissues, a thicker lining appeared in the fibrous mucosa of the palate. In the mandible the greatest bone thickness was found on the buccal side, in the symphysis and in the retro molar area. The mandibular soft tissue showed little lining.

CONCLUSION: Thin layers can host anchorage of no more than 4 mm in length. They are found in the mandibular oral tissues on the lingual side, in the maxilla in the apical portion of the canine-premolar area and in some palatal areas.

14 ORTHODONTIC BONE ANCHORS: A THREE-YEAR CLINICAL EVALUATION

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AIM: To evaluate the success rate of bone anchorage with a modified titanium miniplate under different orthodontic loadings.

MATERIAL AND METHODS: One hundred and nineteen bone anchors placed in 81 patients and used as anchorage for the following applications: 57 to distalise the upper anterior segment after extraction of the first premolars, 22 to distalise the entire upper arch without extractions, 17 to upright mesialised lower second molars and 10 to mesialise molars in the upper and lower arch. Three skeletal Class III subjects were treated with orthopaedic traction between bone anchors in the upper and lower arch after rapid palatal expansion. In one subject an upper molar was intruded. The following loadings were applied to the bone anchors: 150 g elastic forces to distalise the anterior segment in extraction cases; 200 g to distalise the upper molars using sliding jigs; a force and couple of force generated by TMA uprighting springs (0.017×0.025 -inch) on second molars; 250 g for intrusion of the upper molar; 350 g for orthopaedic traction. The mobility of the bone anchor, gingival health and radiographs were clinically evaluated.

RESULTS: The bone anchors were loaded over a mean period of 8.1 months (\pm SD 3.0 months). Only one bone anchor was lost in the maxilla and four in the posterior region of the mandible because of local infection, all within 6 weeks of surgery and before orthodontic loading. The high incidence of failure in the lower arch was attributed to the triangular form of the miniplate used in the lower jaw. Gingival health was good, no major infections or radiolucency were observed except in the five failure cases. The stability of the anchorage was very good, even when heavy forces were applied for a long period.

CONCLUSION: High success rates and development of improved orthodontic applications make skeletal anchorage a good alternative for conventional anchoring techniques.

15 THE ROLE OF THE MSX1 GENE IN HYPODONTIA AND CLEFT LIP AND/OR PALATE

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AIM: A non-syndromic cleft lip with or without cleft palate (CL \pm P) develops by a disturbed fusion of the different branchial arches in the face, between the 6th and 12th week of development post-conception. The cause is frequently unknown but it has been previously shown that the MSX1-gene can play a critical role in craniofacial development. Experiments in homozygous MSX1-deficient transgenic mice have demonstrated cleft palate, failure of incisor development and an arrest of molar development. In humans, four different MSX1 mutations have previously been described in four different families with autosomal dominant tooth agenesis as a common trait. Significant linkage disequilibrium was also found between CL \pm P and MSX1 mutations in mice, suggesting that the MSX1-gene is also involved in the pathogenesis of clefting.

SUBJECTS AND METHOD: To test the hypothesis that MSX1 mutations can cause CLP and hypodontia in humans, four different high-risk groups were screened. These groups were: familial CL \pm P patients without hypodontia, familial CL \pm P patients with hypodontia, CL \pm P patients with familial hypodontia and familial hypodontia patients.

RESULTS: In three siblings of one family with autosomal dominant hypodontia a 559C \rightarrow T mutation resulting in a premature stop codon Q187X was found.

CONCLUSION: Compared with an earlier report (Lidral *et al.*, 2002), these siblings have more teeth missing, suggesting that certain MSX1-mutations can cause agenesis of more teeth than premolars and third molars. No mutations of the MSX1-gene were found in the CLP patients, indicating that MSX1-mutations are very rare and that the CLP phenotype must have a different concurrent (gene) deficiency.

16 REVASCULARISATION AFTER REIMPLANTATION OF MATURE APICOECTOMIZED TEETH

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AIM: To evaluate histologically the quality and amount of ingrowth of new pulpal tissue in mature apicoectomized teeth after removal of the original pulp and reimplantation.

MATERIALS AND METHODS: Four beagle dogs, approximately 6 months old in whom single rooted tooth 64 with complete root development was extracted, and an apicoectomy was carried out. The original pulp tissue was removed from the apical side with a nerve-broach. Before reimplantation, the pulpal cavity in 48 teeth was filled with physiologic water, while in the other 16 teeth the pulpal cavity was left empty. After an observation period of 7, 14, 18, 21, 28, 35, 189, 196 and 210 days, the reimplanted teeth were removed and prepared for histological evaluation.

RESULTS: During the experiment 23 teeth were lost. In the other 41 teeth there was a significant variation in the amount of ingrowth of new tissue, on a short as well as on a long-term basis. The tissue quality was characterised by inflammation in most of the teeth. In some teeth no inflammatory cells were visible. However, in those teeth internal as well as external resorption of the dentine was observed.

CONCLUSIONS: In spite of antibiotic therapy during the experimental period, inflammation of the new pulpal tissues was observed in the experimental teeth. Long-term in almost all teeth ingrowth of epithelium at the borders of the pulpal cavity was noticed. Based on these results further research is necessary to study and to improve the physiology of repair after pulp removal and reimplantation.

17 LEAGUE TABLES FOR PERFORMANCE—HOW SHOULD THEY BE CONSTRUCTED?

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AIM: To provide appropriate measures of performance of orthodontists and a suitable method of comparing them.

MATERIAL AND METHODS: A study of orthodontic treatment in Wales looked at 1087 patients of 18 orthodontists from three different sectors of the dental service, two salaried and one paid on a fee-for-item basis. The severity of the initial and final conditions were assessed using the Index of Complexity, Outcome and Need scoring system, with a successful outcome defined as a final score of less than 30. The performance of an orthodontist can be assessed using the proportion of successful outcomes, together with 95 per cent confidence limits; the initial severity can also be taken into account. It is common practice to produce a league table, a ranking of practitioners based on these crude success rates but it is essential to calculate appropriate measures of uncertainty associated with these ranks. A Bayesian model was used to achieve this.

RESULTS: Crude success rates varied from 15 to 87 per cent. Rankings were produced using the Bayesian methods, giving, for each practitioner, a probability distribution of the different ranking positions. It showed that any of four practitioners, with success rates between 84 and 8 per cent, could have been the best but confirmed that the 15 per cent success rate of one practitioner was certainly the lowest. The effect of the model was to reduce the apparent differences between the practitioners but it gave a rigorous and appropriate way of comparing practitioners.

CONCLUSION: League tables are highly emotive and need to be correctly constructed to be meaningful. The proposed system provides a sensible method for ranking and quantifying the uncertainty in these ranks.

18 NEW GENERATION OPEN BITE TREATMENT WITH ZYGOMATIC ANCHORAGE

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AIM: To achieve maxillary posterior dentoalveolar intrusion and mandibular anterior rotation using zygomatic implants in the treatment of anterior open bites (AOB). In a previous study, surgical miniplates were used as zygomatic implants. These plates were fixed to the inferior border of the zygomatic buttress with minifixation screws and one end of the plate was extended into the oral cavity. The maxillary first molars were banded and a transpalatal arch passing 3 mm apart from the palatal mucosa was constructed. Fixed appliances were applied to the premolars and the second molars. Segmental arches were engaged and the maxillary posterior segments were intruded using NiTi coil springs. Intrusion of the posterior maxillary dentoalveolar segments were achieved and the AOB was closed. For

evaluation of the technique, some modifications were planned: 1) Surgical miniplates were bulky and created hygiene and healing problems, 2) The transpalatal arch was insufficient to prevent buccal tipping of the molars, 3) The lack of three-dimensional control of posterior teeth during intrusion created occlusal interferences.

MATERIALS AND METHOD: To solve the above problems the procedure was modified. New multipurpose implants were designed and constructed from pure titanium and used as zygomatic implants instead of surgical miniplates. An acrylic cap splint covering the posterior teeth, which incorporated two thick transpalatal arches, was used to prevent buccal tipping and developing interferences. NiTi coil springs were applied bilaterally between the acrylic cap splint and the multipurpose implants to intrude the maxillary posterior dentoalveolar segments. The protocol described was used in 10 subjects and cephalometric evaluation was undertaken after six months.

RESULTS: In all subjects maxillary posterior dentoalveolar intrusion was achieved and remarkable closure of the AOB was observed.

CONCLUSION: Zygomatic anchorage supported maxillary dentoalveolar intrusion can be an effective procedure for the treatment of skeletal AOB malocclusions.

19 MISSING UPPER INCISORS IN JUVENILE PATIENTS —A RETROSPECTIVE EVALUATION

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AIM: To re-evaluate the records of patients presenting missing upper incisors between 1998 and 2000 and to analyse the aetiology, diagnosis, treatment planning, anchorage considerations and management of the edentulous sites.

SUBJECTS AND METHODS: Twenty-five juvenile patients (10 females, 15 males, mean age 10.9 years) with one or more missing upper incisors, in total 59 teeth. Seventeen patients were Class II, and four either a Class I or III. In 17 patients the diagnosis was completed by low-dose-dental computed tomography in order to assess clearly the anatomic site, the root morphology or damage to the root surfaces of adjacent teeth. In six patients the anchorage situation was considered to be critical.

RESULTS: Twenty-six teeth were missing due to agenesis, 22 were retained, and 11 were lost traumatically. As a cause for tooth retention four mesiodontes were found and two cysts. In 12 patients the retained teeth were aligned and in seven space closure was achieved orthodontically. In other cases the second incisors were protracted and restored with porcelain veneers. Due to critical anchorage four patients in the mixed dentition period received a cemented Hyrax type appliance with attachments to be used as a 'four × two appliance'. Six juveniles, the youngest not older than nine years, required parasagittal titanium implants (4 mm in length) for maximum skeletal anchorage preparation. None of these mini-implants was lost.

CONCLUSION: As missing incisors are considered to be a great handicap for juvenile patients early therapy is a contemporary demand. The main objective is to reduce the need for prosthetic restoration or implantation by orthodontic therapy. If tooth-borne anchorage is considered to be too weak, mini-implants placed parasagittally in the maxillary vault provide good skeletal anchorage even in growing individuals.

20 TIMING, LOADING AND PLACEMENT OF MINI-IMPLANTS AND IMPLANTS AS ORTHODONTIC ANCHORAGE

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AIM: To show the benefits, possibilities and limitations of mini-implants to obtain rigid skeletal anchorage for tooth movements.

SUBJECTS AND METHOD: Fifty-one patients in whom 35 mini-implants and 37 fixtures to control anchorage were inserted. In some adult patients, orthodontic anchorage may be more difficult to achieve because of missing teeth and wide edentulous spaces. In these situations, the implants may be used initially as skeletal anchorage to facilitate tooth movement, and secondarily as abutments for fixed prostheses.

RESULTS: Using the fixtures as skeletal anchorage resulted in some problems because of the severity of surgery, the discomfort of initial healing, a longer period of treatment time and they could only be inserted in the retromolar, tuberosity and edentulous areas, demonstrating limitations for the direction of force application. The use of mini-implants as anchorage produced satisfactory results in a short period of time with two minimal surgical procedures, and enabled insertion of an appliance in any aimed position and permitted easy tooth movements. This is very important for preventing dental, periodontal, aesthetic and psychological problems during orthodontic treatment.

CONCLUSIONS: Tooth movement that is difficult or impossible with conventional tooth-borne and osseointegrated fixture anchorage, is possible with mini-implants.

21 INDICATIONS FOR ORTHODONTIC SPACE CLOSURE IN THE INCISOR REGION: THE PROFESSIONALS' AND PATIENTS' VIEWPOINT

W Harzer, Department of Orthodontics, Technical University of Dresden, Germany

AIM: To assess the morphological and functional advantages and disadvantages of orthodontic space closure from the patient's perspective.

SUBJECTS AND METHODS: Thirty patients (13 boys, 17 girls) treated orthodontically for space closure due to aplasia or traumatic loss of the incisors and 50 patients with a full dentition of the same age. The morphological analysis was carried out as indicated by Eismann and for the functional analysis Helkimo's method was used. For assessment of the patient's view of the treatment result the Eastman Aesthetic Index was used.

RESULTS: Space closure caused marked occlusal alterations, but apparently no damage to the temporomandibular joint or to muscle action, provided the treatment was completed before 12 years of age. Eighty per cent of patients were satisfied with the result. Criticism factors were the colour difference between incisor and canine and the shape of the canine.

CONCLUSION: Compared with subjects with a full dentition or implant insertion in the case of missing incisors, orthodontic space closure is a better alternative if treatment starts before 10 years of age. The patients appreciate the short treatment time and complete dentition without permanent prosthetic replacement.

22 EFFICIENCY OF EARLY ORTHODONTIC TREATMENT—A LITERATURE STUDY SINCE 1979

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AIM: There are different opinions where the benefit and efficiency of early orthodontic treatment is concerned in evaluation of treatment time, result at the end of treatment and costs. The aim of this study was to extract from the literature the timing of orthodontic therapy.

MATERIAL AND METHOD: Medical databases were analysed concerning early orthodontic treatment. From 1979 to 2002, 91 studies were identified evaluating advantages of early treatment, influences on dental and skeletal changes, growth pattern, initial degree of anomaly, and efficiency of treatment considering the costs and treatment time in terms of the result at the end of treatment.

RESULTS: Splitting the 91 studies according to type resulted in 14 prospective and 58 retrospective clinical studies, while 19 dealt only with the literature itself. Comparing all of the material, 97 studies related to different Angle Classes, 43 to transverse and 33 to vertical anomalies. By evaluating the type of treatment, 28 described fixed appliances, 27 functional appliances and 12 removable plates. Extra-oral appliances were discussed in 46 articles, no therapy in six, and slicing in four. Early treatment of vertical and transverse anomalies seemed to enhance orthognathic development. Treatment of Angle Class II with headgear and functional appliances provoked significant dental and skeletal changes with better results with the use of headgear, but large individual variability. Class III treatment with facemask, chin cap and functional appliances showed dental and skeletal changes in the primary and mixed dentition. Dental compensation outweighed skeletal effects.

CONCLUSION: Summarising the literature, early treatment showed better results than conventional commencement of treatment or treatment of adults. Both, patient and orthodontist seem to benefit from early treatment regardless of the longer treatment time. Depending on the severity of the case, early treatment could decrease the negative influence of anomaly on development.

23 FUNCTIONAL APPLIANCES: A MINORITY REPORT FROM AMERICA

L E Johnston, Jr, University of Michigan, USA

KEYNOTE ADDRESS

In medicine, there are accepted rules for early diagnosis and treatment. Chief among them is the requirement that early intercession actually lead to improved outcomes. In the collected apocrypha of functional orthodontics, better profiles, fewer extractions, easier treatment, and a reduced need for surgery are the commonly reported gains. Brochures, including those describing the American Association of Orthodontists' early-examination campaign, feature a more complete listing of anticipated benefits, both for the clinician and the patient. Unfortunately, the refereed literature is considerably more circumspect. Functional appliances clearly 'work', at least in the sense that they can improve many malocclusions. But how do they work? Do they really grow jaws? The lecture circuit is of little help. Among its denizens, few trouble to consider the mechanisms of facial growth. Mainstream biology, it would seem, is irrelevant. In the end, questions remain. What do functional appliances have to do with function? How is function supposed to grow mandibles? Indeed, do functional appliances have any measurable effect on facial growth? Which, if any, of the various popular claims are true? These questions are important. More to the point, their answers should be equally important to the day-to-day practice of orthodontics.

It will be the purpose of this presentation to consider whether functional-appliance outcomes are different in some important ways from those of the single-stage, fixed-appliance therapies they would supplement or supplant. In the process, it will be suggested that, in order to 'work', functional appliances need not modify the pattern of facial growth, that their effect may not differ markedly from that produced by conventional headgear therapy, and that their use may be reduced to a simple practice-management decision.

24 STABILITY AFTER MANDIBULAR BODY OSTEOTOMY IN CLASS III OPEN BITE MALOCCLUSIONS

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AIM: Long-term stability can be a problem after some types of orthognathic surgery in Class III open bite patients. The aim of this

study was to evaluate the results of the mandibular body ostectomy (modification of Dingman) in these patients.

SUBJECTS AND METHOD: Twenty-eight patients in whom a mandibular body ostectomy was performed to correct a Class III open bite malocclusion were invited for evaluation of long-term changes. To-date 10 subjects have attended. Cephalometric radiographs obtained pre- and post-surgery and at the long-term review were analysed. Dental and skeletal changes were evaluated.

RESULTS: Overjet was improved during surgery (mean: 7.2 mm; range: 2.8 to 12.5 mm). Long-term change was not significant. Overbite was changed during surgery (mean: 3.5 mm; range: 1.0 to 5.2 mm). The long-term change was not significant -0.6 mm (-1.5 to +1.0 mm). Wits was improved during surgery (mean: 6.2 mm; range: 1.4 to 9.9 mm). The long-term change was not significant +0.3 mm (-0.3 to +2.3). Lower face height (Spa-Me) diminished during surgery (mean: -3.0 mm; range: +0.3 to -7.8 mm). The long-term change was not significant. The changes in posterior face height (S-Go) were not significant after surgery or at the long-term observation.

CONCLUSION: There is very good skeletal and dental stability after mandibular body ostectomy for Class III open bite malocclusions. The patients show good stability without any orthodontic post-surgical treatment or retention.

25 SKELETAL ANTERIOR OPEN BITE IN CHILDREN AND ADOLESCENTS WITH MYOTONIC DYSTROPHY

S Kiliaridis, H Kjellberg, C Morel, Departments of Orthodontics, University of Geneva, Switzerland, and Göteborg University, Sweden

AIM: To investigate the occlusal traits and craniofacial morphology of children with congenital or early onset myotonic dystrophy.

SUBJECTS AND METHODS: Twenty-seven patients, 3 to 18 years of age, were examined and compared with a matched group of healthy individuals. The dental arches and the occlusal traits were analysed on dental casts. Lateral cephalograms were taken only in the patient group to be compared with cephalometric norms of healthy individuals.

RESULTS: A high prevalence of malocclusions ($P < 0.05$) such as an Angle Class II, anterior open bite and lateral crossbite were found among the patient group, characterized by a narrow maxillary dental arch. The craniofacial morphology of patients with myotonic dystrophy showed a vertical aberration, characterized by a large angle between the mandibular and palatal planes ($P < 0.01$), and a steep mandibular plane ($P < 0.01$).

CONCLUSIONS: The influence of the masticatory muscles from the disease may be the crucial factor related to the skeletal and dental arch deviations in children with myotonic dystrophy. Longitudinal recordings of these individuals will shortly take place and the evaluation procedure will provide the knowledge needed to define the correct timing and appropriate orthodontic treatment goals for these patients.

26 SYSTEMATIC DIAGNOSIS OF THE DENTITION—IMPORTANCE OF PREVENTING ORTHODONTICALLY PROVOKED ROOT RESORPTION

I Kjær, Department of Orthodontics, University of Copenhagen, Denmark

AIM: To design an electronic registration form (database) that enables visualisation/identification of dentitions predisposed to orthodontically provoked root resorption.

MATERIAL AND METHODS: Radiographs from 782 children with deviations in the dentition were investigated and the information

was submitted to the database. The deviations concerned: number of teeth, types of malformation, types of eruption disturbances, etc. The radiographs had been forwarded from community dental clinics in Denmark for consultation. An electronic registration form was established according to the main and the associated diagnostics of the dentition. The location of the dental deviation (unilateral/bilateral, maxillary or mandibular occurrence and the actual teeth involved) was determined. In addition, the type of tissue responsible for the deviation was identified (mucosa/ectoderm, neural tissue/neuro-ectoderm, and mesoderm/ectomesenchym). Lastly, the aetiology of the dental deviation was suggested, and distinctions were made between congenital and acquired deviations.

RESULTS: The registration form allowed distinction between simple and complicated dental deviations. The complicated deviation predisposes for orthodontic root resorption.

CONCLUSIONS: It is possible to identify dentitions predisposed to orthodontic root resorption using a registration form that combines clinical findings with basic knowledge on tissue interaction.

27 MAXILLARY LATERAL INCISOR IMPLANTS: OVERCOMING THE AESTHETIC CHALLENGES

V G Kokich, University of Washington, USA

KEYNOTE ADDRESS

Implants are now used routinely in dentistry. Pure titanium and hydroxyapatite-coated titanium implants have revolutionized removable and fixed prosthodontics. Today orthodontists have become involved in the interdisciplinary treatment of patients that receive single-tooth implants replacing missing maxillary lateral incisors. These patients require careful planning and co-ordination between several specialties in order to avoid an aesthetic catastrophe. Implant location, size of fixture, age of placement, need for bone grafting, and potential pitfalls are all critical aspects that the team members must understand. This presentation will address these important issues and describe how to overcome the aesthetic challenges of maxillary lateral incisor implants.

28 SEVERELY INFRAOCCLUDED PRIMARY MOLARS

A Komorowska, M Pucek, A Lasota, Department of Jaw Orthopedics, Medical Academy of Lublin, Poland

AIM: To describe the severe degree of infraocclusion of primary molars together with commonly associated features.

MATERIAL AND METHODS: Clinical examination, dental pantomograms, models and intraoral photographs of 29 patients (18 girls, 11 boys) aged 7 to 16 years.

RESULTS: Infraocclusion of the upper and/or lower primary molars was associated in 25 per cent with agenesis of the permanent successors. When present, the premolars were impacted and displaced. Deeply infraoccluded primary molars in several cases were totally covered by gingiva or the gingival margin around them was levelled more apically in relation to adjacent teeth. A considerable reduction of alveolar height could be also demonstrated. The immediate mesial and distal neighbours were tipped and intercoronal space for an infraoccluded primary molar was significantly smaller than the width of its crown. The roots of adjacent teeth were displaced away from the infraoccluded tooth and the interapical distance was increased. Spacing of the lower teeth occurred. The dental midline was deviated to the affected side in unilateral cases, both in the upper and lower arch.

CONCLUSION: The above findings may be used for improvement of treatment strategies in patients with severely infraoccluded primary molars.

29 LOW-INTENSITY ULTRASOUND STIMULATES BONE CELL DIFFERENTIATION

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AIM: Several investigations have established the stimulatory effect of pulsating low-intensity ultrasound treatment on osteogenesis and fracture healing. This study aimed to examine whether the stimulatory effect of low-intensity ultrasound can be explained by increased bone cell activity and/or proliferation. Therefore the effect of low-intensity ultrasound in an *in vitro* endochondral ossification model was tested, and histomorphometric analysis on the calcified diaphysis and bone collar of foetal mouse metatarsal bone rudiments was performed.

MATERIALS AND METHODS: Twenty-four paired triplets of metatarsal bone rudiments of 12, 17-day-old foetal mice were dissected and divided into two groups. After 24 hours of preculture one group was treated with low-intensity ultrasound (30 mW/cm²; 1.5 MHz) for 20 minutes per day for three or six days. The other group served as controls. After cessation of the experiment the bone rudiments were prepared for computer-aided light microscopy. The parameters analyzed were: bone collar volume, bone collar length, calcified cartilage length, calcified cartilage percentage, and cell number.

RESULTS: General linear measurement analysis demonstrated that low-intensity ultrasound treatment significantly enhanced bone collar volume ($P = 0.032$) and calcified cartilage percentage ($P = 0.016$). Bone collar length and calcified cartilage length were not affected by ultrasound treatment. Ultrasound treatment did not change cell proliferation, as indicated by similar cell numbers in the control and ultrasound-treated cultures.

CONCLUSION: The stimulatory effect of low-intensity ultrasound on endochondral ossification is due to stimulation of cell differentiation and matrix production, rather than cell proliferation.

30 COST-EFFECTIVENESS ANALYSIS IN ORTHODONTICS

A M Kuijpers-Jagtman, University of Nijmegen, The Netherlands

KEYNOTE ADDRESS

During the past decade there has been increasing emphasis on economic health care interventions. Firstly economic evaluation of health care programmes deals with choices between diagnostic or therapeutic options, implying alternative ways to allocate resources and, secondly, with the relationship between costs and effects. If a study does not analyse both issues, it cannot be considered to be a full economic evaluation.

Economic evaluation of care has started to evolve in dentistry but is used less frequently in orthodontics. However, it is anticipated that it will become increasingly important especially as the relevance of cosmetic correction is questioned when resources are limited.

A Medline search on 'orthodontics', 'cost-effectiveness' and 'economic evaluation' resulted in only 54 articles over the last 20 years and a closer look at those publications showed that they hardly fulfil the criteria for state-of-the-art economic evaluation. It was also found that the terms 'cost-effectiveness' or 'cost-benefit' are widely misused.

31 LONG-TERM SKELETAL AND SOFT TISSUE EFFECTS AFTER DISTRACTION OSTEOGENESIS

M Kulewicz, Z Dudkiewicz, D Cudzilo, Department of Orthodontics, National Research Institute for Mother and Child, Warsaw, Poland

AIM: To evaluate the skeletal and soft tissue profile changes associated with distraction osteogenesis (DO) of the craniofacial skeleton. **SUBJECTS AND METHOD:** Between 1999 and 2002, 64 patients have undergone surgery for congenital craniofacial deformities using DO. Forty-two patients had mandibular distraction and 22 midface

distraction. Photographs and lateral and postero-anterior cephalograms were taken to study changes in the facial structures before treatment (T0), and 3 (T1), and 12 (T2) months post-distraction. To describe the average positional changes, horizontal and vertical reference lines were used. The horizontal line was defined as a line through nasion rotated 7 degrees upwards from the SN-plane. Vertical values were measured from this horizontal line. For sagittal measurements, the vertical line was defined as the line perpendicular to the horizontal line through sella. Twenty linear and 12 angular variables were calculated.

RESULTS: Significant improvements in facial aesthetics were achieved in all patients. The analysis reflected the improvement of most evaluated parameters (both linear and angular).

CONCLUSION: DO is a valuable method for improving skeletal relationships and soft tissue profiles.

32 CRANIOFACIAL CHANGES IN CHILDREN WITH CLEFT LIP AND PALATE AFTER DISTRACTION OSTEOGENESIS

M Kulewicz, Z Dudkiewicz, D Cudzilo, Department of Orthodontics, National Research Institute for Mother and Child, Warsaw, Poland

AIM: Cleft lip and palate (CLP) patients can present with maxillary retrusion with a tendency to a Class III malocclusion after cleft repair. During recent years distraction osteogenesis has been used as an alternative to maxillary osteotomies and bone grafting in cleft palate maxillary hypoplasia. The aim of this presentation is to show the results of using external and internal devices for correction of midface hypoplasia and analyses of the long-term stability of skeletal and soft tissue changes after maxillary advancement with distraction osteogenesis. **MATERIAL AND METHODS:** Twenty-two CLP patients, aged 12 to 18 years of age with severe maxillary and midface hypoplasia were treated using two different techniques after complete Le Fort I osteotomy: one group underwent facemask protraction (14 patients), and the other group (8 patients) internal distraction (Dynaform-Leibinger). Facial and occlusal photographs and lateral cephalometric radiographs were obtained pre-operatively, and 3 and 6 months after distraction. Cephalometric analysis was performed to compare the sagittal craniofacial and soft tissue morphology before and after distraction.

RESULTS: With internal and external maxillary distraction, the maxilla was significantly advanced. Midface advancement between 10 and 15 mm was achieved in all patients without complications. Maxillary distraction improved the profile by increasing nasal projection, normalizing nasolabial angle, and making the upper lip more prominent. The facial concavity changed to facial convexity. The profile changed from prognathic to orthognathic. The final occlusal relationship was satisfactory and the negative overjet in all patients was corrected to normal values. Post-distraction cephalometric evaluation revealed normalization of most cephalometric values. No relapses were observed. All patients were kept under orthodontic control during distraction.

CONCLUSION: Distraction osteogenesis offers new perspectives in the early treatment of midface hypoplasia. The major advantage is the ability to direct and control the maxilla during distraction. Maxillary distraction is an effective option for maxillary hypoplasia in cleft patients.

33 ORTHODONTIC TREATMENT PLANNING FOR SINGLE TOOTH IMPLANTS IN PATIENTS WITH CONGENITALLY MISSING LATERAL INCISORS

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AIM: The insertion of implants after space opening in patients with missing incisors is a new prosthetic perspective but there is a risk of

alveolar bone loss between the completion of orthodontic treatment and placement of the implant. The aim of the study was to optimise treatment planning for space opening in subjects with congenitally missing lateral incisors.

MATERIAL AND METHODS: Forty plaster casts of 20 patients with orthodontic space opening and missing lateral incisors were used for calculation of the cross-section of the alveolar bone, sliced at the level of implant insertion. The first cast (T1) was taken between 9.9 and 14.5 years of age (start of treatment) and the second (T2) between 11.3 and 15.8 years of age (finish). For calculation of cross-section in the buccal-palatal direction a microscope, Leica MZ 12, with the software Leica Qwin was used.

RESULTS: When considering the implant dimension (3.5 to 10 mm) the buccal part of alveolar bone surface varied from 15.5 mm² to 30.0 mm² at T1 and decreased to 9.3 mm² and 21.0 mm² at T2. The distance between implant and bone buccal surface was, in subjects where early treatment had been undertaken, less than 1 mm. The vertical decrease was significant. The thickness of the bone layer was between 2 and 5 mm if the treatment started later than 14 years of age.

CONCLUSION: Orthodontic treatment that commences after the completion of facial growth is indicated for preservation of bone in the missing tooth space.

34 OSTEOCLAST RECOGNITION AND ACTIVITY AT VARIOUS REGIONS OF THE DENTAL ROOT

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AIM: To determine if regional variations of the dental root confer susceptibility to external apical root resorption (EARR). The hypothesis tested is that regional variation of dentine between the apical, middle and coronal regions contributes to osteoclastic attachment and activity.

MATERIALS AND METHOD: Freshly extracted premolars from individuals up to the age of 18 years were cleared of cementum and sectioned for resorption assays. Freshly harvested osteoclasts were seeded on to the dentine slices in culture. Osteoclasts were evaluated for attachment and counted. Resorption pits were measured and expressed as the percentage area of the dentine slice.

RESULTS: Osteoclast attachment was not significantly different between the three regions ($P = 0.99$). However, the total resorbed area was significantly greater at the apical region compared with the middle and coronal regions ($P < 0.05$).

CONCLUSIONS: Inherent differences in the apical region of the dental root confer susceptibility to osteoclastic resorption, independent of biomechanical and other treatment factors.

35 ORTHODONTIC VERSUS IMPLANT-PROSTHETIC SPACE CLOSURE IN SUBJECTS WITH MISSING UPPER INCISORS

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AIM: To retrospectively compare treatment results after orthodontic space closure with those after prosthetic treatment with space opening and implant insertion. An evaluation of the long-term results may contribute to an understanding of the indications, advantages and disadvantages to help clinicians to make the appropriate decision for their individual treatment planning approach, especially in borderline cases.

SUBJECTS AND METHOD: Twenty patients (average age 21.5 years) who had undergone orthodontic space closure and 20 patients (average age 25.3 years) with restoration of the missing tooth with an implant. Different parameters such as aesthetics, function and periodontal parameters were statistically analyzed.

RESULTS: Clinical implications: The disadvantages of orthodontic space closure include a longer treatment time with fixed appliances and more complex therapy, e.g. balancing extractions. On the other hand this group showed improved periodontal health in comparison with those with prosthetic replacements. In the case of implant insertion a local alveolar rich augmentation is essential for a good aesthetic result. A further disadvantage is the longer rehabilitation time.

CONCLUSIONS: When evaluating the two alternative treatment concepts, both options can be regarded as adequate solutions. However, each clinician must be able to establish carefully an overall treatment plan for the individual patient, i.e. the choice of the correct technique.

36 SCREENING BIOMATERIALS FOR SAFETY

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'Proposition 65', now law in California, considers clinicians 'responsible for the materials they use'. In the near future, other countries could adopt similar legislation, generating, as in the United States, a crisis in malpractice insurance.

Orthodontics uses metal devices that can lead to malfunctioning, allergies and even to tissue necrosis, brittle ceramics known to cause splintering and enamel breakage, and plastics that may cause inflammation, poisoning, cancer and hormonal disruption. While not substituting for the more sophisticated ISO or other organization's recommended evaluations, simpler, do-it-yourself tests are suggested to screen offensive devices.

Thus, immersion of the metal attachment in acid gels with added colour-changing reagents allows the detection of those leaching nickel. Among these, Unitek's Unitwin one piece cast bracket showed the highest amount of nickel release. A flame-spectrophotometric analysis showed that the amount released was, or approached the acceptable limit of 0.2 mg Ni per bracket established by the Ministry of Health and Welfare of Japan, Standard 1985.3.30 No. 294.

The immersion of minced plastic devices in an oxidizing, colour-changing potassium permanganate solution allows the detection of leaching monomers, oligomers and additives. Among these, a Tru-Fit Junior mouth guard from Becton Dickinson Co. was found to leach the most. Its immersion in water at room temperature showed, after 24 hours extraction with hexane, a decrease in weight of 35 per cent, or 2.45 g or 50 µg/kg/day of a plasticizer that could well contain 2-diethyl hexyl phthalate (DEHP). To this amount, which reaches *per se* the limit considered tolerable for children by the European Union Scientific Committee on Food, should be added the average level of exposure to DEHP from all sources in the general population (3 to 30 µg/kg body weight/day).

37 INTRACELLULAR SIGNALLING SCIENCE IN OSTEOBLASTS

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KEYNOTE ADDRESS

Osteoblasts are pivotal to bone biology. Recent advances have highlighted a synchronous co-ordination of osteoblast and osteoclast activity whereby the osteoblast collates all signals applied to the bone and relays that information to the osteoclast via well-characterised cytokines. The resorption of the bone and its matrix then releases growth factors held within the matrix which stimulate the osteoblast to lay down new osteoid. The focus of this work was to identify and dissect the various cytosolic intracellular signalling pathways within osteoblasts and establish the importance of each under different

conditions comparable to the clinical setting. In brief two basic signalling pathways exist; one is linked with a seven transmembrane spanning protein and specific receptors for ligands (the G protein linked pathways) and one with protein phosphorylation especially of the tyrosine kinases. The specific areas of interest are the ways in which calcium activity within the cell is modified and used as a signal for further activation and possibly differential gene activation. Two pathways have been identified. Firstly mechanical deformation of cells leads to a rapid (within 500 ms) change in intracellular calcium concentration (Ca^{2+}) but to enable this increase there has to be an intact G protein pathway. Secondly the activation of a collagen peptide motif that appears to stimulate osteoblasts via a tyrosine kinase pathway has been identified. The precise nature of activation by this peptide has yet to be clarified.

Subsequent to identifying the different stimuli that act upon the two types of pathways a possible role of oestrogen in maintaining the G protein based pathways has been identified. Cells simulated by oestrogen have specific levels of the G proteins which will provoke a response when, for example, parathyroid hormone targets the cell. When oestrogen is withdrawn from these cells the levels change such that the response to parathyroid hormone would change.

From the data it is clear that Ca^{2+} is essential to intracellular signalling pathways and the complexity of this signal may describe the variations of gene activity identified following variations of cell stimuli.

Awarded the James IV Professorship of the Royal College of Surgeons of Edinburgh

38 ORTHODONTIC IMPLANTS—WHICH ROLE DO THEY PLAY?

B Melsen, University of Århus, Denmark

KEYNOTE ADDRESS

Anchorage has always played an important role in orthodontic treatment. In adult patients where an insufficient number of teeth or reduced periodontium is present, anchorage may pose an unbridgeable problem. This is also the case where the forces acting on the reactive unit generate undesirable tooth movements. In these cases intra-oral extra-dental anchorage is indicated. Several intraosseous systems have been developed. Some have relied on osseointegration and only loaded after a lag-time. Others have been immediately loaded. Some have a one-point contact while others offer three-dimensional control. These anchorage systems have widened the range of orthodontic treatment possibilities.

The choice does, however, depend on the individual need for anchorage. The tissue reaction surrounding the implants is of importance in the selection of loading both with regard to timing and quantity of the force. In case of immediate loading it is important that the strain developed corresponds to the envelope that leads to bone formation.

39 ORTHODONTIC TREATMENT OF PATIENTS WITH A HIGH MANDIBULAR ANGLE

R S Nanda, University of Oklahoma, USA

KEYNOTE ADDRESS

Controlling the vertical dimension in orthodontic treatment of high angle patients is challenging because almost all orthodontic procedures have an extrusive effect on the molars resulting in hinging the open bite. Not only is there a risk in opening the bite anteriorly, there is also the possibility of posterior rotation of the mandible and lengthening of lower anterior face height, which can have negative effects on the facial profile.

A simple vertical holding appliance has been developed which has been clinically evaluated for impeding the vertical dentoalveolar

development of the maxillary molars and it has been found to be useful. Another adjunct to this procedure is using the fixed lingual arch on the mandibular molars to control their vertical growth. Both procedures when applied early in the development of the permanent dentition can be beneficial. The appliances are simple to construct and are easily accepted by the patients.

40 PROFILE, POSTURAL AND MORPHOLOGICAL EVALUATION AND ASSESSMENT OF PREMOLAR ROOT MORPHOLOGY FOLLOWING HERBST TREATMENT

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AIM: To study whether Herbst appliance treatment of Class II division 1 malocclusions is associated with changes in head posture, craniocervical angulation, soft tissue profile and premolar root morphology.

SUBJECTS AND METHODS: Twenty-five growing patients (19 boys, 6 girls; mean age: 13 years) with severe Class II division 1 malocclusions were treated for an average period of 13 months by means of the Herbst appliance. Lateral cephalometric radiographs taken in the natural head position and periapical radiographs were obtained using the parallel technique before appliance insertion and immediately after its removal. Head posture, craniocervical angulation and soft tissue profile were assessed by means of 17 cephalometric variables. For evaluating changes in the premolars, both length and surface of their roots were measured. Statistical elaboration included the Kolmogorov-Smirnov trial and paired *t*-test.

RESULTS: Herbst appliance treatment of Class II division 1 malocclusions was not associated with significant ($P < 0.05$) changes in head posture or premolar root morphology. On the other hand significant improvement took place in many cephalometric variables of the soft tissue profile including the angles of convexity, upper and lower lip as well as the distances of the upper lip to the E-line, the thickness of the upper lip, soft tissue chin, and lower lip.

CONCLUSIONS: The hypotheses that forward mandibular repositioning may be associated with changes in head posture and craniocervical angulation and that the heavy forces exerted by the appliances to the supporting premolars may induce root resorption cannot be supported. On the other hand, Herbst appliance treatment was associated with beneficial alterations of the soft tissue profile of these young patients.

41 HELP OR HINDRANCE?—THE RELEVANCE OF MASSETERIC ADAPTABILITY TO VERTICAL FACIAL DEVELOPMENT

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AIM: To establish whether differences in masseter muscle structure, in terms of myosin heavy chain (MyHC) expression, fibre cross-section area (CSA) and fibre type, amongst individuals with varying vertical facial form (VFF) are indicative of differences in adaptive response to changes in functional environment using statistical modelling.

MATERIALS AND METHODS: Masseter muscle biopsies were collected from 13 long face syndrome (LFS), 15 normal VFF and 10 short face syndrome (SFS) individuals undergoing orthognathic surgery. MyHC expression was analysed using Western blotting and fibre CSA and profile were analysed using immunohistochemistry and the TEM software program. Pre-treatment and pre-surgery static occlusion was analysed using study models. A pilot study had shown this method to be accurate and reliable. Statistical analysis was performed using MLwiN multilevel modelling software.

RESULTS: MyHC isoform expression in intermediate/hybrid fibres was highly significantly inversely related to the number of pre-surgery occlusal contacts ($P < 0.001$) and, for a given number of occlusal contacts, was also highly significantly influenced by the VFF of an individual ($P < 0.001$). The fibre CSA was highly significantly positively associated with the pre-surgery occlusion ($P < 0.001$), and this was also significantly influenced by the VFF of an individual ($P < 0.001$).

CONCLUSIONS: Hybrid fibres and their constituent MyHCs, not detected routinely in the adult, are expressed in masseter muscles adapting to a change in occlusion brought about by orthodontic treatment. Differences in MyHC expression and fibre CSA amongst the masseter muscles of the three vertical facial groups, for a given number of occlusal contacts, suggest differences in muscle adaptability between the groups. SFS individuals are more able to adapt to a change in functional environment than LFS individuals.

42 HOW EFFECTIVE IS EARLY TWIN BLOCK TREATMENT? A UNITED KINGDOM BASED MULTI-CENTRE RANDOMISED CONTROLLED TRIAL

K O'Brien, University of Manchester, England

KEYNOTE ADDRESS

AIM: To evaluate the effectiveness of early orthodontic treatment with the Twin Block appliance for the developing Class II division 1 malocclusion. This multi-centre trial was carried out in the United Kingdom.

SUBJECTS AND METHOD: One hundred and seventy-four children 8–10 years of age with a Class II division 1 malocclusion were randomly allocated to receive treatment with a Twin Block appliance or to an untreated control group. Data were collected at the start of the study and 15 months later.

RESULTS: Early treatment with Twin Block appliances resulted in a reduction of overjet, correction of the molar relationship and reduction in the severity of the malocclusion. Most of this correction was due to dento-alveolar change and some to favourable skeletal change. There were also differences in self-esteem and childhood experience between the groups.

CONCLUSIONS: It appears that early treatment with the Twin Block appliance is effective in reducing an overjet, severity of malocclusion and improvement in self-esteem and childhood experience. Nevertheless, the small change in the skeletal relationship may not be considered to be clinically significant.

43 EARLY OR LATE HERBST TREATMENT—WHICH APPROACH IS MORE STABLE?

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AIM: To analyse the long-term stability of Herbst therapy in relation to the treatment growth period.

SUBJECTS AND METHODS: Eighty-two Class II division 1 Herbst appliance treated subjects were followed to the end of growth. In relation to the pubertal peak of growth, the subjects were treated during three growth periods: Pre-Peak ($n = 21$), Peak ($n = 31$) and Post-Peak ($n = 30$). Lateral head films in habitual occlusion were analysed on three occasions: before treatment, after treatment and at the end of growth (5–7 years after treatment). The treatment and post-treatment changes of a variety of skeletofacial variables were assessed.

RESULTS. Treatment changes: For the different variables no differences existed between the three growth groups except for the soft tissue profile angle including the nose (NsNoPg) which was increased

(profile convexity reduced) more in the Post-Peak than in the Pre-Peak group. Post-treatment changes: Unfavourable changes were seen for the variables: ANB, Wits, NsNoPg and sagittal lip position (ULT-line and LL/E-line). Favourable changes were seen for: ML/SL, SNB and lower face height. For all variables (favourable as well as unfavourable) post-treatment changes were largest in the Pre-Peak and smallest in the Post-Peak group.

CONCLUSION. Considering unfavourable post treatment changes in a long-term perspective, late (Post-Peak) Herbst treatment exhibited more stable results than early (Pre-Peak) treatment.

44 PREMOLAR AUTOTRANSPLANTATION IN ORTHODONTIC TREATMENT—25 YEARS EXPERIENCE

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KEYNOTE ADDRESS

Tooth transplantation is a biological procedure that may be integrated in treating certain orthodontic problems: premolar aplasia and avulsed or malformed anterior teeth, which are common in young people. Using autotransplantation, it is possible to resolve difficult problems in the dental arches by relocation of space. Clinical examples, timing of transplantation and soft tissue healing, as well as tooth eruption and orthodontic rotation, based on a large study sample will be presented. The outcome between autotransplantation of teeth with soft tissues and the use of osseointegrated implants will be compared.

45 MAGNETIC RESONANCE IMAGING OF MUSCULAR CONDITION AFTER VERTICAL DISTRACTION OF THE RAMUS

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AIM: Distraction osteogenesis has become a frequently used procedure in the treatment of craniofacial deformities. Reaction of the bone has been discussed but little attention has focused on the soft tissue reaction. Earlier studies have shown resorptive changes in the gonial angle after vertical elongation of the ramus, which might be caused by an increase in masseter muscle tension. The aim of this study was to evaluate and verify changes in the masseter and external pterygoid muscles as a side-effect of vertical ramus distraction.

SUBJECTS AND METHODS: Six patients, four females, two males, mean age 14.7 years, who had undergone vertical ramus distraction. Growth disturbances were caused by juvenile arthritis, arthrosis and trauma. There were nine distraction sites in the group. T1 weighted magnetic resonance (MR) scanning was applied before and after the distraction procedure. Horizontal and coronal directions were used to examine the masseter and external pterygoid. As reference for the direction of the MR imaging planes, the longitudinal axis of the corpus callosum was used. The mean time between first and second scanning was 11 months, with the second being carried out after distraction and orthodontic appliance removal.

RESULTS: The asymmetric patients all showed a difference in muscle size in the two sides before distraction. After distraction the muscles at all distraction sites showed deterioration. In the asymmetric patients a change in angulation of the ramus was seen but no rotation of the condyle.

CONCLUSION: Vertical ramus elongation will lead to changes in muscle tissue that can be observed over a relatively short period. Whether these changes persist have to be studied in a long-term follow-up in these patients.

46 DISTRACTION OSTEOGENESIS IN HEMIFACIAL MICROSOMIA

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AIM: To evaluate attainment of facial symmetry by unilateral distraction osteogenesis in patients with hemifacial microsomia (HFM).

SUBJECTS AND METHODS: Thirteen HFM patients (mean age 5 years 11 months), six having Pruzansky type I and seven type II mandibular deformity. The patients had undergone unilateral distraction osteogenesis using an external, unidirectional distraction device. Postero-anterior cephalograms were obtained at the start of distraction and at the end of the activation period. Pre- and post-operative angles between the occlusal and mandibular planes with reference to the orbital plane, and the facial symmetry angle between the facial and mandibular midlines were measured. Ramus height on both sides was also measured and the ratio between the affected and non-affected side calculated. The orientation of the distraction device was described as horizontal ($n = 4$), oblique ($n = 5$) or vertical ($n = 4$). ANOVA was used to assess statistical significance between the outcome and the HFM type and the distractor vector.

RESULTS: On the distracted side ramus height increased, on average, by 13.7 mm, leading to an increase in the ratio of distracted over non-distracted ramus height from pre-distraction 0.61 to post-distraction 0.90. Straightening was noted in the mandibular occlusal plane and mandibular plane angle in relation to the orbital plane. Similarly, the mandibular midline approached that of the facial midline confirming improvement in facial symmetry.

CONCLUSION: Facial symmetry can be improved considerably by unilateral distraction osteogenesis in patients with HFM.

47 THE EFFECT OF EARLY CERVICAL HEADGEAR ON CROWDING—A RANDOMIZED EIGHT-YEAR FOLLOW-UP STUDY

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AIM: To determine the long-term effects of early headgear treatment on dental arches and occlusion.

SUBJECTS AND METHODS: Sixty-four children of both sexes aged 7.6 years (SD 0.3 years) with a Class II tendency in occlusion and moderate crowding. The children were randomly divided into two groups of equal size, matched according to gender. In the first group headgear treatment was initiated immediately. The mean treatment time in the headgear group was 16 months. In the second group, which served as the control, only interceptive procedures were performed during the first follow-up period. During the later follow-up, fixed appliance therapy and extractions were carried out if necessary. The study casts were taken after follow-up periods of two and eight years. Linear measurements on dental casts were carried out with a three-dimensional measurement system based on a machine vision technique.

RESULTS: Extraction of the first premolars was necessary in 34 per cent of the control group. In the headgear group 16 per cent required extractions but only in the lower arch. In subjects with no extractions, the linear dimensions in the headgear group were significantly larger both in the transverse and sagittal dimensions and in both dental arches, after the follow-up period of eight years.

CONCLUSION: Early use of cervical headgear is effective in expanding the dental arches and the space gain is significant in both arches at the long-term follow-up.

48 MULTIDISCIPLINARY TREATMENT OF CONGENITALLY MISSING INCISORS

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AIM: To investigate the clinical outcome of multidisciplinary treatment with implants in subjects with agenesis.

SUBJECTS AND METHOD: Twenty-two implants placed in 15 patients (mean age 20.5 years). Eleven patients had received orthodontic treatment several years previously; two required additional orthodontic treatment prior to implant placement and four underwent orthodontic therapy immediately before surgery. All of the prosthetic restorations were metal-ceramic cemented on customized screw retained abutments. The observation period ranged from 14 to 121 months (mean 50.3 months).

RESULTS: No implant failures were registered. A total of three elements (13.6%) had prosthetic complications (screw loosening); none of them required a new crown. Screw loosening resulted in peri-implant tissue inflammation, which resolved after screw tightening. Soft tissue conditions around the restorations were comparable with those of the patients' natural teeth. An acceptable and stable aesthetic appearance was found in most subjects, although in four (18.2%) a change in the relative position of the implant-supported crown to adjacent teeth was clinically evident; and in one patient this required additional surgical procedures.

CONCLUSIONS: Some problems experienced could probably have been avoided through different clinical management of the case. In some patients additional orthodontic treatment prior to implant placement would probably have been necessary to achieve a better result. The choice between orthodontics alone or multidisciplinary treatment should always be carefully considered at the time of total treatment planning. Overall, dental implants are a good treatment option for replacing congenitally missing incisors. However the effects of post-adolescent craniofacial changes are still largely unknown, as well as the response of an implant supported crown to complex long-term occlusal changes.

49 THE TIMING OF ORTHODONTIC TREATMENT: NEW EVIDENCE

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SHELDON FRIEL MEMORIAL LECTURE

Orthodontic treatment generally is carried out at the time of the adolescent growth spurt, which is also the time the succedaneous permanent teeth usually erupt. This timing provides an excellent combination of treatment effectiveness (success) and efficiency (cost/benefit ratio). The major indication for delaying orthodontic treatment until after adolescence is prolonged unfavourable growth, especially mandibular prognathism. Early (pre-adolescent) treatment is often recommended, but can be justified only if it is more effective, i.e. produces a better result than later treatment. Because early treatment almost always must be followed by a second phase of treatment during adolescence, the patient's time in treatment and cost are likely to be greater.

In this lecture, treatment timing will be considered in the light of new evidence as to the effectiveness and efficiency of treatment for Class I crowding/protrusion, Class II and Class III problems. The recent randomized clinical trials of early versus later Class II treatment offer a particularly valuable perspective on the virtue of data rather than opinion when alternative clinical procedures must be evaluated. Despite the lack of clinical trial data for Class I and Class III problems, indications and contra-indications for early treatment are becoming clearer.

50 OPEN BITE: CONSIDERATIONS FOR EFFECTIVE TREATMENT

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KEYNOTE ADDRESS

An anterior open bite (AOB), more than any other type of malocclusion, is influenced by environmental factors, such as thumb sucking, tongue posture and respiratory pattern. It also is strongly related to skeletal proportions and patterns of growth. The principal signs of skeletal open bite are a short mandibular ramus, which is unlikely to be due solely to environmental factors, and a rotated palatal plane, which may reflect physiologic adaptation to changes in tongue and jaw posture related to environmental influences. In the absence of skeletal involvement, an open bite in children often improves spontaneously, and treatment at early ages is unnecessary. However, spontaneous correction of an open bite rarely occurs once adolescent growth begins. In older patients, an AOB almost always is due to excessive eruption of posterior teeth, not deficient eruption of incisors, and treatment must focus on controlling posterior eruption and downward growth of the posterior maxilla. In adults, non-skeletal open bites due to tipped and protrusive incisors can be corrected by retracting the incisors, but if excessive vertical growth of the maxilla has occurred, surgery to vertically reposition the maxilla usually is the preferred treatment. Recent data confirm that this provides excellent long-term success.

A posterior open bite has two major causes: (1) interference with eruption of the teeth, as from placement of the tongue between the teeth, which can be treated successfully if the interference can be removed; and (2) problems with the eruption mechanism of posterior teeth, which prevents their eruption even when an eruption path has been cleared. Because eruption failure is due to abnormal periodontal ligament activity, these teeth do not respond to orthodontic force and cannot be moved into occlusion. The differential diagnosis is important to prevent undertaking treatment with no chance of success.

51 ADVANTAGES OF EARLY TREATMENT OF PSEUDO CLASS III

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AIM: To investigate the long-term outcome of early treatment of pseudo Class III malocclusions, using a simple fixed appliance and to compare it with untreated controls.

SUBJECTS AND METHOD: Twenty-one consecutively treated pseudo Class III malocclusion patients with a mean age of 9.6 years. Fifteen untreated pseudo Class III subjects in the permanent dentition were used as controls. The subjects in the treated group were followed for 5 years. Lateral cephalograms and study models were analysed for the treated, the control and the follow-up group.

RESULTS: Anterior crossbites and mandibular displacement were corrected after treatment and relapse was not observed during the follow-up period. The angulations of the upper incisors to the maxillary plane showed a mean increase of 9.5 degrees ($P < 0.001$), whereas the angulation of the lower incisors to the mandibular plane showed a decrease of 4.9 degrees ($P < 0.001$). A comparison of the space available as a result of early treatment with space required for alignment of teeth in the upper arch of the untreated group indicated that there was sufficient space for the eruption of the canines and premolars as a result of early treatment, whereas lack of space was evident in the untreated controls.

CONCLUSIONS: Early treatment of pseudo Class III by proclination of the upper incisors provides sufficient space for the eruption of the buccal segments; erupting canines and premolars are guided into a

Class I relationship after early correction of anterior mandibular displacements.

52 TREATMENT RESPONSE AND LONG-TERM STABILITY OF ANTERIOR OPEN BITE MALOCCLUSIONS

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AIM: To study treatment response and long-term stability of anterior open bite (AOB) malocclusions in orthodontically treated patients. **SUBJECTS AND METHODS:** Fifty-eight consecutive AOB patients treated orthodontically. Dental casts and lateral cephalometric radiographs were analysed before treatment (T0), after treatment (T1), two years post-treatment (T2) and at least 5 years post-treatment (T5).

RESULTS: The mean AOB at T0 was 5.3 mm (range: 0.7 to 10.1 mm). In 10 subjects (17%) a compromise treatment with only levelling of the dental arches was planned. In less than half of the subjects (26 patients, 45%), a positive overbite was reached at T1, while in 22 patients (38%) the AOB improved with treatment but could not be completely closed. Four of the 26 successfully treated patients showed an AOB at T2 and T5, while in the remaining patients the AOB correction was found to be stable.

CONCLUSIONS: Treatment response of an AOB malocclusion to orthodontic treatment is relatively poor. However, the long-term stability of patients that could be successfully treated was surprisingly good.

53 OSTEOCLAST DIFFERENTIATION DURING STANDARDISED ORTHODONTIC TOOTH MOVEMENT IN YOUNG AND ADULT RATS

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AIM: To evaluate osteoclast differentiation during orthodontic tooth movement in young and adult rats.

MATERIAL AND METHODS: Standardised orthodontic tooth movement was performed in two groups of 30 male Wistar rats, a juvenile group aged 6 weeks and an adult group aged 9–12 months. A split mouth design was chosen. The three maxillary molars on the experimental sides were moved as one unit mesially by a Sentalloy closed coil spring that delivered a force of 10 cN over a long range of activation. The contralateral molars served as controls. At 1, 2, 4, 8, and 12 weeks groups of animals were killed for histological evaluation. Immunohistochemical staining with ED1-antibody was used to identify osteoclasts. The number of osteoclasts at the mesial sides of the roots of the second and third molars were counted. Differences between the experimental and control sides were calculated as measures for the effects of the intervention, and analysed with a Student's *t*-test.

RESULTS: Both the juveniles and adults showed an increase in osteoclast numbers at the early experimental time points. In the juveniles this number reached a maximum of 15.3 ± 5.8 at 2 weeks. At that time the number in the adults was significantly lower (5.6 ± 3.1 ; $P < 0.01$). The osteoclast numbers in the adult animals reached a maximum of 24.5 ± 0.58 at 4 weeks. This was significantly higher than in the juvenile group at that time (8.6 ± 3.2 ; $P < 0.01$). At 8 and 12 weeks the osteoclast numbers decreased in both groups, but remained higher in the adults than in the juveniles ($P < 0.01$).

CONCLUSION: Orthodontic forces induce faster osteoclast differentiation in juveniles than in adults. This may be the reason for the initial delay reported in tooth movement in adult orthodontic patients.

54 EFFECTIVENESS OF BONDED LINGUAL RETAINERS IN CONTROLLING RELAPSE OF THE LOWER INCISORS

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AIM: To study the effectiveness of the 3–3 lower lingual stainless steel retainer (bonded only on the canines) in controlling relapse of the orthodontic treatment result in the lower anterior region.

MATERIALS AND METHODS: Dental casts of 194 consecutive patients who received a 3–3 lower lingual stainless steel retainer after active orthodontic treatment were studied before treatment (T0), after treatment (T1) and two (T2) and 5 (T5) years post-treatment. The irregularity index according to Little (1975) was used to describe the contact point displacement of the lower anterior teeth.

RESULTS: The mean irregularity index was reduced from 7.4 mm (SD = 4.1) at T0 to 0.6 mm (SD = 0.9) at T1 and increased during the post-treatment period to 0.9 mm (SD = 1.1) at T2 and 1.0 mm (SD = 1.1) at T5. In 114 patients (59%) the irregularity index did not change in the 5-year post-treatment period (T5–T1), while in 80 patients (41%) the average change was 0.4 mm (SD = 0.7).

CONCLUSIONS: The 3–3 lower lingual stainless steel retainer (bonded only on the canines) is effective in controlling relapse of the orthodontic treatment results in the lower anterior region in the majority of cases. However, in a relatively high percentage of cases an increase in lower incisor irregularity might take place.

55 CHOICE OF TREATMENT FOR 128 MISSING UPPER LATERAL INCISORS—A POPULATION STUDY

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AIM: To evaluate the treatment principles of patients with lateral incisor hypodontia.

MATERIALS AND METHOD: During orthodontic screening in the 5th school grade from 1992 to 2002, all children with hypodontia were recorded. From 2002, the choice of treatment in the region of all missing teeth was recorded according to the following categories: A: No decision made (A0: not categorized, A1: decision postponed); B: Spontaneous space closure (B1: ongoing, B2: completed); C: Active space closure (C1: ongoing, C2: completed); D: Autotransplantation (D1: planned, D2: completed); E1: Indication for replacement (E1T: persisting temporary tooth, E10: no temp. tooth, active space regaining); E2P: Removable prosthetic replacement inserted; E2B: Bridgework (temporary or conventional) inserted. E2I: Implant inserted.

RESULTS: From the 4,812 screened individuals, 86 showed agenesis of one or two upper lateral incisors (1.8%). Forty-four individuals (23 females, 21 males) were missing one and 42 individuals (27 females, 15 males) were missing both upper lateral incisors. In total 128 lateral incisors were missing and the distribution according to choice of treatment was as follows: No treatment (category A and B): 32.8 per cent, orthodontic space closing treatment (category C): 36.7 per cent and space opening and prosthetic replacement (category E): 30.5 per cent.

56 EVALUATION OF THE TEMPOROMANDIBULAR JOINT AFTER BILATERAL SAGITTAL SPLIT OSTEOTOMY

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AIM: Combined surgical-orthodontic treatment is frequently undertaken in patients with mandibular prognathism and improved stomatognathic function is a frequent and sometimes the primary goal of patients seeking surgical correction of dentofacial deformities. The aim of this study was to assess the changes in condyle position and

stomatognathic system functions in patients with mandibular prognathism after mandibular setback surgery.

SUBJECTS AND METHODS: Fifteen patients (mean age 22.4 years) undergoing combined orthodontic and surgical treatment for their skeletal Class III malocclusions were evaluated 1 week before surgery (T1), 1 month after the end of intermaxillary fixation (T2) and 6 months after surgery (T3). Standardized lateral, antero-posterior, basilar cephalograms and transcranial radiographs were used to assess the changes in condyle position. Stomatognathic system function was evaluated using electrovibratography and electromyographic records during resting, swallowing and clenching. Mandibular movements during various functions were also evaluated.

RESULTS: Mediolateral movement, superior-inferior movement and the rotational change of the condyles were not significant for the two time intervals ($P > 0.05$). There was a significant increase in the posterior joint space of the right temporomandibular joint from T2 to T3. More than 50 per cent of the patients had unbalanced muscle activity during clenching and swallowing, and this number increased significantly after surgery. Although their number decreased at T3, more than half of the patients still had unbalanced muscle activity 6 months after surgery. Maximum interincisal opening decreased immediately after surgery but returned to its original value 6 months after surgery. Trajectory patterns, freeway space, opening and closing times during chewing were not significantly affected.

CONCLUSIONS: No significant changes were seen in condylar position or stomatognathic system functions after mandibular setback surgery.

57 RAPID MAXILLARY EXPANSION: IS IT BETTER IN THE MIXED OR PERMANENT DENTITION?

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AIM: To assess the sagittal, transverse, and vertical effects of a modified acrylic bonded rapid maxillary expansion (RME) device used in the mixed dentition and to compare these effects with those resulting from the use of a RME in the permanent dentition.

SUBJECTS AND METHOD: Fifty-one patients in the mixed or permanent dentitions (26 females, 25 males) who underwent RME treatment. Group I comprised subjects in the mixed dentition (19 females, 15 males; mean age, 9.2 ± 1.3 years) and group II, seven females and 10 males (mean age 12.7 ± 1.2 years) in the permanent dentition. Records were collected before (T1), after treatment (T2) and after retention (T3). Eighteen measurements were performed on lateral and postero-anterior cephalograms and plaster models. Intra- and inter-group changes were evaluated by paired and independent sample *t*-tests.

RESULTS: Following RME, the maxilla moved forward, the mandible rotated posteriorly, face height increased, nasal, maxillary, and maxillary intercanine and intermolar widths increased and the upper molars tipped buccally in both groups. Almost all of these significant changes were stable at the 6-month follow-up (T3). When overall (T1–T3) differences were considered, the upper molars tipped more and ANB angle increased less in the mixed dentition group compared with the permanent dentition group ($P < 0.01$).

CONCLUSION: The orthopaedic effects of RME are not greater at an early age and tipping of anchorage molars is higher in the mixed dentition.

58 SOLUBLE PHOSPHATE-BASED GLASS FIBRES AS A SCAFFOLD FOR REGENERATING MASSETER MUSCLE

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AIM: Tissue engineering of craniofacial skeletal muscle is a realistic alternative to the current options to replace deficient tissue. There is

also the potential to alter muscle phenotype where intrinsic muscle diseases may be the cause of an obvious facial deformity and possibly to enhance the stability of orthognathic appliances and treatment with orthopaedic appliances. The aims of the study were to (1) identify a primary human masseter muscle-derived cell culture with a high myogenicity; (2) determine whether soluble phosphate-based glass fibres can support the *in vitro* adhesion, proliferation and differentiation of human masseter muscle-derived myoblasts, and the influence of various parameters on this.

MATERIALS AND METHODS: Immunocytochemical techniques were used to distinguish between satellite cells, non-muscle cells and differentiating myotubes *in vitro*. Soluble phosphate-based glass fibres were seeded with cells obtained from primary masseter muscle-derived cell cultures. Glass fibre configuration, cell density, growth factors and extracellular matrix components were examined to determine their influence on skeletal muscle regeneration on these glass fibres. Modulation and phase contrast microscopy, time-lapse footage, and immunofluorescence imaging utilising a Leica DMIRB microscope, a COHU CCD camera and Leica FW4000 imaging software helped determine outcome.

RESULTS: (1) A meshed configuration of glass fibres allowed cell attachment mainly at the fibre intersections; (2) Glass fibres that had settled onto the substrata allowed myotubes to orientate; (3) Matrigel was ideal for cell attachment; (4) The density of the seeded cells influenced the likelihood of cell attachment; (5) Insulin-like growth factor I was obligatory for the differentiation of myoblasts on the glass fibres.

CONCLUSIONS: Soluble phosphate-based glass fibres can be used as a scaffold for the *in vitro* engineering of human skeletal muscle.

59 COST-EFFECTIVENESS OF CLASS II MIXED DENTITION TREATMENT

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AIM: Cost-effectiveness analysis of Class II treatment in the mixed dentition compared with corrective treatment with fixed appliances. **SUBJECTS AND METHOD:** One hundred and twenty-four patients with a Class II division 1 malocclusion, overjet 5 mm and more treated with orthodontic appliances. The active treatment was performed in eight orthodontic practices. Beginning of treatment I-VI/1998, examination VI/2002. Group I consisted of 55 patients treated with removable appliances in the late mixed dentition. In 39 patients the treatment was finished, in 16 cases interrupted by the patient. Group II had 69 subjects treated with fixed appliances in the permanent dentition. The cost of the treatment was taken according to the Health Insurance expenditure. The change of malocclusion was assessed using the Peer Assessment Rating (PAR) Index. The cost-effectiveness was defined as the proportion of cost to PAR improvement.

RESULTS: The mean cost of treatment with removable appliances was 5,341 CZK, including those with interrupted treatment it was 5,085 CZK. The mean cost of treatment with fixed appliances was 8,295 CZK. The average PAR change in group I was 9.4 PAR points, and including those whose treatment was interrupted 6.7 PAR points. The average PAR change in group II was 18.3 PAR points. The cost for 1 PAR point improvement was 568 CZK in group I, 759 CZK including patients with interrupted treatment and 453 CZK in group II for Health Insurance expenditure.

CONCLUSION: Fixed appliances result in a higher treatment standard and their cost-effectiveness is above that of removable appliances. Moreover, a large number of patients will require further treatment after removable appliance therapy.

60 LONG-TERM RESULTS OF MANDIBULAR DISTRACTION OSTEOGENESIS IN HEMIFACIAL MICROSOMIA

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AIM: Mandibular lengthening using distraction osteogenesis is considered effective for the correction of facial asymmetry. However, there are few reports on long-term stability. The aim of this investigation was to determine long-term stability of mandibular lengthening in subjects with facial asymmetry.

SUBJECT AND METHODS: Eight patients with facial asymmetry and mandibular lengthening using distraction osteogenesis performed between 1993–1997. All patients had hemifacial microsomia, except one who suffered from temporomandibular joint (TMJ) ankylosis caused by infection. Mandibular lengthening was performed using external appliances during growth. Frontal facial photographs were taken before distraction, immediately after distraction and after more than five years. Three rating grades (good, fair and poor) were used for the long-term outcome evaluation.

RESULTS: All patients showed a good facial appearance immediately after mandibular lengthening. Long-term results, however, were poor in all patients with hemifacial microsomia. The result for the patient with TMJ ankylosis was good. These differences were considered to be due to the cause of the facial asymmetry. With hemifacial microsomia, the defects affect both the skeleton and soft tissues, while the patient with an acquired disease had normal growth potential originally.

CONCLUSION: Long-term results of mandibular lengthening using distraction osteogenesis in hemifacial microsomia are unstable, whilst in the patient with acquired disease the result was considered to be acceptable.

61 INDIAN HEDGEHOG: A MECHANOTRANSDUCTION MEDIATOR IN MANDIBULAR CONDYLAR CARTILAGE

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AIM: Indian hedgehog (Ihh) acts as a critical mediator transducing mechanical signals to stimulate chondrocyte proliferation. The aims of this investigation were to clarify the cellular signal transduction pathway that senses and converts mechanical signals into tissue growth in the mandibular condyle, and evaluate the expression of Ihh and its relationship to the kinetics of replicating mesenchymal cells in condylar cartilage in natural growth and during anterior mandibular displacement.

MATERIALS AND METHODS: Fifty female Sprague Dawley rats at 35 days of age were randomly divided into five control and experimental groups ($n = 5$). The experimental animals were fitted with functional appliances that continuously positioned the mandible 3.5 mm forward. Before sacrifice on days 3, 7, 14, 21 and 30, the rats were double labelled with two thymidine analogues in order to estimate the cell cycle of the replicating mesenchymal cells. The animals were first given an intraperitoneal injection of iododeoxyuridine (IdU) followed 1 hour later by another injection of bromodeoxyuridine (BrdU), and killed 1 hour after the last administration. The condyles were harvested and sections were obtained from the mid-sagittal plane. Immunohistochemical staining was carried out to discriminate the labelled cells with two specific antibodies. The temporal and spatial expression of Ihh was also evaluated by immunochemistry.

RESULTS: Compared with natural growth, mandibular advancement led to a significant increase of replicating mesenchymal cell numbers for the first 14 days. The turnover time was shortened, without altering the S-phase of the cell cycle. Ihh was mainly localized in the proliferative and chondroblast layers, with a significantly higher

expression in the proliferative layer on days 3 and 7 after mandibular advancement.

CONCLUSION: Mandibular forward displacement promotes the amount and also the speed of the proliferation of mesenchymal cells. Ihh acts as a mediator of mechanotransduction in chondrogenetic cells in the condyle by converting mechanical signals to stimulate cellular proliferation.

62 A LONGITUDINAL STUDY TO ASSESS FACIAL ATTRACTIVENESS

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AIM: To assess the change in facial attractiveness over a period of 20 years and evaluate the influence of various factors that may affect facial appearance. The objectives were to determine whether: 1) Children look more attractive than adults; 2) Attractive children become attractive adults; 3) Attractive adults look younger than unattractive adults; 4) Smiling makes people look more attractive; 5) Orthodontic treatment improves facial attractiveness; 6) Orthodontic treatment makes teeth look better.

SUBJECTS AND METHOD: Sixty individuals were selected from a sample of 331, who attended the Cardiff longitudinal study in the year 2001. Facial photographs for the selected subjects (3/4 views, smiling and non-smiling) were taken at 11 and 31 years of age. A questionnaire was devised with a 9-point rating scale for various facial features and questions about the subject's overall facial attractiveness as well as age. Twelve 30 to 31 year old non-dentists (equal numbers of males and females) were invited to rate 240 photographs of the 11 and 31-year-old subjects. Inter-examiner reliability was assessed using the generalisability theory and differences between the groups were evaluated using non-parametric tests.

RESULTS: 1) Children look more attractive than adults ($P < 0.002$); 2) 51 per cent of attractive children (both smiling/non-smiling groups) become attractive adults whilst 19/30 per cent of unattractive children (non-smiling/smiling groups, respectively) become attractive adults; 3) Attractive adults look younger than unattractive adults ($P < 0.000$); 4) Smiling makes people look more attractive (in adults only) ($P = 0.018$); 5) Orthodontic treatment does not improve facial attractiveness ($P = 0.25$); 6) Orthodontic treatment makes teeth look better ($P < 0.000$). Inter-examiner reliability was 0.85 (high level of agreement).

CONCLUSIONS: There are many factors that affect facial attractiveness. Orthodontic treatment makes teeth look better, but does not generally make an individual attractive. Other factors contribute to attractiveness.

63 TREATMENT TIMING FOR CLASS II MALOCCLUSIONS: EFFICACY, EFFECTIVENESS AND EFFICIENCY

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KEYNOTE ADDRESS

Clinical decision making for patients with Class II malocclusions must include consideration of how the timing of treatment might affect treatment outcome and treatment efficiency. Data from a two-phase parallel randomized controlled trial was used to provide information on issues of treatment efficacy, what changes occur; treatment effectiveness, the proportion of patients achieving certain results; and treatment efficiency, the time and methods used to achieve these outcomes. The results suggest that the precise timing of treatment for these children may not be necessary. When children whose treatment

started in the mixed dentition were compared with those for whom treatment was delayed to the permanent dentition, there were, on average, few differences in skeletal change, dental occlusion, treatment complexity or treatment time. These results were the same for all practitioners providing care in Phase 2 of the trial.

64 UNILATERAL POSTERIOR CROSSBITE AND CHIN DEVIATION: IS THERE A CORRELATION?

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AIMS: To find an answer to the following questions: 1. Is there a correlation between unilateral posterior crossbite (UPXB) and clinical discernible chin deviation? 2. How large should a chin deviation be before it is noticed? 3. Are there differences between the judgement of professional dental observers and laymen? 4. Does visual assessment of chin deviation compare well with computer-assisted assessment of chin deviation?

SUBJECTS AND METHODS: Seventy-two patients with a UPXB and a control group ($n = 72$) without a UPXB matched for age and sex. In addition, a computer-designed face was added with chin deviations of 0, 2, 4, 6 and 8 mm to the left. The full-face slides of these groups were shown twice, with an interval of two weeks, to an audience of professional dental judges and laymen, judging with the bare eye. A computer-assisted assessment was also carried out in order to create a standardised comparison to visual scoring.

RESULTS: Inter-observer examination of visual scoring showed moderate agreement ($Kappa = 0.48$). When comparing the computer assisted and visual scores, the intraclass correlation coefficient appeared to be 0.87. In 70.3 per cent (on average) of the cases with a UPXB, the observers visually noticed a deviation in the same direction as the crossbite.

CONCLUSIONS: 1. Bare eye scoring of chin deviations is difficult. 2. There is a correlation between a UPXB and clinically discernible chin deviation. 3. The vast majority of the observers noticed a chin deviation of at least 4 mm. 4. There were no major differences between the assessment of chin point deviations between the seven orthodontists and 10 dental students, but the five laymen showed slightly worse reproducible answers.

65 VARIATION IN ANTERIOR TOOTH MORPHOLOGY AND ITS EFFECT ON TORQUE USING PRE-ANGULATED BRACKETS

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AIM: To determine the variation in crown-root angle of the upper incisors and canines as well as the variation in their labial contour.

MATERIALS AND METHODS: Radiographs, taken from a proximal view, of 160 extracted maxillary teeth (80 incisors, 80 canines) were digitized and analyzed with Paint Shop Pro and Mathcad professional. The incisal edge, the centre of the cemento-enamel junction and the root apex were digitized to define the crown and root long axis. For all teeth the crown-root angle was measured. At several heights on the labial surface a tangent was determined, enabling measurement of the inclination of the buccal surface.

RESULTS: The crown-root angle had a great variability ranging from 165 to 193 degrees for the canines (mean 177°) and from 165 to 189 degrees for the incisors (average 176°). In addition an obvious increase in the standard deviation of the labial curvature was noted for both teeth at a position of 5 mm or more from the incisal edges.

CONCLUSION: According to the variation of the crown-root angle as well as the labial curvature of upper incisors and canines, edgewise brackets with pre-adjusted torque may result in a large spread of torque at the end of treatment. Placement of the brackets too gingivally (>5 mm from the incisal edge) will result in an even larger variation of final torque.

66 CHANGES OF mRNA AND PROTEINS IN MASSETER MUSCLE AFTER ORTHOGNATHIC SURGERY

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AIM: The force to moment ratio of masticatory muscle changes after orthognathic surgery. The essential protein for muscle contraction is myosin heavy chain (MyHC). The aim of the study was to quantify the amount of MyHC proteins and MyHC mRNA in muscles of patients with different positions of the mandible before and after surgery.

SUBJECTS AND METHODS: Fifteen adults divided into two groups with distal and mesial malocclusion and a third group who had undergone rehabilitation. The mRNA expression of two MyHC isoforms of the anterior and posterior part of the right and left masseter muscle were analysed with a competitive PCR assay before and six months after surgery. Different isoforms of the MyHC protein were identified by Western blot analysis.

RESULTS: The masseter muscle from patients with distal occlusion contained primarily more type I and IIX MyHC mRNA than those with mesial occlusion ($P < 0.05$). There was a remarkable post-operative decrease in mRNA types and in type I protein. The change in patients following rehabilitation was less pronounced.

CONCLUSIONS: Differences in facial shape may be associated with differences in mRNA expression of MyHC isoforms. The commonly

used molecular-biological methods are suitable to investigate the functional status of masticatory muscles.

67 ORTHODONTIC TOOTH MOVEMENT TO REGENERATE NEW ALVEOLAR TISSUE AND BONE FOR IMPROVED SINGLE IMPLANT AESTHETICS

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KEYNOTE ADDRESS

Using different methods and techniques, teeth can be moved orthodontically either with the marginal periodontium attached or out of the periodontium. The soft and hard periodontal tissues will generally follow the tooth as it is moved, both in the vertical and horizontal planes of space. Moving teeth with the periodontium is a predictable biological way of regenerating new periodontal tissues to increase soft and hard tissue volume. Such regeneration is particularly valuable when associated with fabrication of artificial crowns on single tooth implants, allowing a natural emergence from the gingiva.

In the horizontal plane, the mesial or distal movement of premolars (and other teeth) over areas of alveolar bone that apparently are too thin labio-lingually for implant insertion will create solid areas of new bone on the tension sides. When the correct amount of space and bone has been developed, quite different and much improved conditions have been created for implant insertion.

In the vertical plane, slow 'orthodontic extraction' will regenerate new periodontal tissues following forced eruption of teeth with a poor long-term prognosis. The extrusion will create improved gingival and alveolar bone conditions for implants in both the anterior and posterior regions of the oral cavity. Enhanced aesthetics and increased levels of osseointegration for the single tooth implants were created.

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