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Houston Orals

H0 01 EVALUATION OF BIOCHEMICAL AND STRUCTURAL CHANGES IN THE PERIODONTAL LIGAMENT AFTER ORTHODONTIC TOOTH MOVEMENT BY MEANS OF MICRO-RAMAN SPECTROSCOPY Fabrizia d'Apuzzo¹, Maria Lepore², Carlo Camerlingo³, Vincenzo Grassia¹, Letizia Perillo¹, Departments of ¹Orthodontics and ²Experimental Medicine, University of Campania "Luigi Vanvitelli", Naples and ³Superconductors, oxides and other innovative materials and devices, CNR-SPIN, Naples, Italy

AIMS: To use micro-Raman spectroscopy (μ RS) to systematically examine the biochemical and structural changes occurring in human periodontal ligament (PDL) samples obtained from extracted premolars after different time points of orthodontic force application.

SUBJECTS AND METHOD: Consecutively recruited subjects with an age range between 11 and 24 years who required orthodontic treatment with upper and/or lower first premolar extractions. Before extractions, a closed coil spring was attached between the first molars and premolars of the right mid-arch, considered the test side, after a 1 mm unilateral distal interproximal reduction of the first premolar with a diamond bur. The left mid-arch was used as the control side. The patients were randomly divided into three groups, whose extractions were accomplished after 2, 7 and 14 days of force application. A PDL sample with dimensions of a few 3 mm was scarified from the same side of the radicular tooth surface of the extracted premolars. The samples were fixed in paraformaldehyde then stored in ethanol. Raman spectra were acquired for each PDL sample with a Jobin-Yvon TriAx 180 Raman system in the range of 500-3000 cm^{-1} and the more relevant vibrational modes of proteins and lipids (Amide I, CH₃ bands) were assessed.

RESULTS: Analysis indicated that the protein secondary structure in the PDL samples after different time points of orthodontic force application was modified. In particular, the Raman response in the Amide I spectral region confirmed the important role of the alpha-helix conformation to limit damage due to external forces and avoid collagen fibre breaks by the configuration changes featured by the enhancement of the Raman signal from alpha3(10)-helix and beta-sheet secondary structures. In addition, changes in the lipid spectral region (2800-3000 cm^{-1}) due to local hypoxia and mechanical force transduction were observed.

CONCLUSION: The reported results indicated that μ -RS represents a valuable tool for investigating the molecular interchain interactions and conformational modifications in the periodontal fibres after orthodontic tooth movement, providing a quantitative evaluation of the time occurring for readjustment at the molecular level of PDL tissue.

H0 02 ASSOCIATION BETWEEN QUALITY OF LIFE AND SEVERITY OF PROFILE DEVIATION IN PROSPECTIVE ORTHOGNATHIC PATIENTS

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AIMS: To evaluate whether the severity of skeletal facial profile deviation associates with quality of life and psychosocial factors in orthognathic patients and to determine if it is possible to analyse patients' orthognathic quality of life based on lateral head films and cephalometric measurements.

SUBJECTS AND METHOD: The study consisted of 55 patients admitted for orthognathic treatment. Skeletal profile was assessed from lateral head films using cephalometric analysis. The following angles were used to assess the sagittal position of the upper and lower jaw and profile: SNA, SNB and ANB. For vertical assessment, gonial angle and the angle between SN- and the mandibular-plane were used. Merrifield's Z-angle was used to assess soft tissue profile. The severity of the skeletal facial profile deviation was assessed by the deviation in ANB angle. Orthognathic quality of life (OQoL) and psychosocial factors were defined with four questionnaires: OQoL Questionnaire, General Symptomatic Index of the Symptom Checklist-90, Rosenberg Self-Esteem Scale, and a body image questionnaire.

RESULTS: An increase in ANB deviation was associated with an increased awareness of dentofacial deformity (OQoL questionnaire subscale awareness of dentofacial deformity, OQLQ-AoDD, $r = 0.319$, $P = 0.017$). A significant difference between ANB angle and OQOL-AoDD was found ($\chi^2 = 6.78$, $P = 0.034$) when ANB angle was stratified into three categories: G1) ANB = 0-4 degrees G2) ANB < 0 degrees and G3) ANB > 4 degrees. Furthermore, categories G1 and G2 differed significantly ($U = 50.5$, $P = 0.017$). An increase in ANB angle was also associated with a more positive body image ($r = 0.342$, $P = 0.023$). There were no significant correlations between other cephalometric variables, quality of life and psychosocial factors.

CONCLUSION: Skeletal facial profile seems to be associated with some aspects of OQoL. Professional cephalometric analysis of the severity of facial profile deviation correlates with patients' awareness of their own facial and dental appearance.

HO 03 CLEFT SUSCEPTIBILITY LOCI CONTRIBUTE TOWARDS VARIATIONS IN NORMAL LIP PHENOTYPES

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AIMS: Craniofacial morphology is highly heritable, which is likely to be attributable to genetic variants. Genome-wide association studies (GWAS) have demonstrated some success in identifying genetic variants that may contribute to facial variation. Several studies have investigated whether genetic variants that have been previously associated with non-syndromic cleft lip or palate (NSCL/P) may contribute to subtler effects on the morphology of the face in unaffected individuals. These studies have used landmarking methods which are sparse in the lip region, and subsequently identifying genetic variants has proved to be largely elusive. The aim of this study was to identify genetic variants associated with deviations in normal lip morphology, using a detailed categorical scale.

MATERIALS AND METHOD: Three-dimensional laser scanned facial images were obtained of 3,687 15-year-old children of European ancestry (ALSPAC). A detailed assessment of lip morphology was performed using the Wilson-Richmond scale. Genotype data was available for GWAS.

RESULTS: Following GWAS, 24 loci associated with 16 different lip phenotypes were identified. One association reached genome-wide significance; chin dimple and rs11017876 ($P = 2.3 \times 10^{-8}$). This SNP is located within 10q26.13 locus, which is a cleft susceptibility region (Carlson *et al.*, 2016, 2017) and has been proposed to play an important role in lip and facial development (Bachler and Neubuser 2001, Stanier and Pauws 2012). Twenty-three other suggestive associations arose, of which, five were in cleft susceptibility loci, suggesting that cleft genes may affect normal variation in lip morphology. Subsequently, 19 independent NSCL/P SNPs were selected, based on previously demonstrated associations with clefting in European populations. A polygenic risk score (PRS) combining the 19 NSCL/P SNPs was associated with V-shaped Cupid's bow ($P = 3 \times 10^{-4}$) and narrow philtrum ($P = 2 \times 10^{-4}$) phenotypes. Analysis of individual SNPs found strong evidence for an association between rs227731 and a Skeletal II pattern ($P = 5 \times 10^{-6}$).

CONCLUSION: Known NSCL/P SNPs affect lip phenotypes in the general population, and an increased PRS is associated with a narrow philtrum and a V-shaped Cupid's bow.

Short Oral Presentations

OP 01 SURVIVAL GROUPS OF PRIMARY MOLARS WITH HYPOPLASIA OF THE PERMANENT SUCCESSORS

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AIMS: To describe and compare changes of primary molars with hypodontia of the permanent successors in a long-term study of children until the end of growth and to evaluate aetiological theories regarding different developments of the missing successors.

SUBJECTS AND METHOD: Eighty seven patients with 132 primary molars were consecutively included in the study from standardized, systematic screenings used in the need of orthodontic service in the Municipal Dental Health Service. Standardized body height was assessed at every exposed standardized dental radiograph. Primary molars were grouped and recorded after

differences in changes, and evaluated after aetiological theories. The material was grouped: unchanged root proportions, surface root resorption, ankylosis root resorption, caries sequelae, and pressure resorption caused by eruption of neighbouring teeth.

RESULTS: Early-developed agenesis (genetic) showed primary teeth without root resorption. Otherwise, regions with later-developed aplasia (environment) showed primary teeth prone to root resorption, as if eruption of a 'ghost tooth' (the tooth sac and the periodontal ligament) takes place. In one group ongoing infraposition was found at puberty. Serious root resorption and persistence in infraposition (ankylosis) were a problem in about 50 per cent of the primary molars affected with hypodontia of the permanent successors.

CONCLUSION: It is advised to follow primary teeth with hypodontia of permanent successors radiographically over a number of years before evaluation of treatment care. 1. Agenesis is genetic hypoplasia of the successor's hard and soft tooth material: Leave the primary molar untreated. 2. Aplasia is environment hypoplasia of the successor's hard tooth material: alternative individual possibilities: a) close affected space, b) autotransplantation of a selected permanent tooth, c) implant after growth has ceased.

OP 02 DOES TARGETING THE HEME-OXYGENASE SYSTEM DETERMINE THE DEVELOPMENT OF CONGENITAL MALFORMATIONS AND ABORTION VIA MODULATION OF THE INFLAMMATORY RESPONSE?

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AIMS: A cleft lip and/ or palate (CLP) is the most common facial congenital malformation. Interaction of both genetic and environmental factors, including alcohol, tobacco, drugs, metabolic disturbances, infectious diseases, lack of oxygen, haemorrhage, haemolysis and inflammation are thought to be involved, although the exact mechanism of orofacial clefts is unclear. Foetal and placenta development in mice following inhibition of the activity of the cytoprotective enzyme heme-oxygenase (HO) with tin mesoporphyrin (SnMP) with or without administration of pro-inflammatory heme was studied. It was postulated that heme would promote oxidative stress, inflammation and pathological pregnancy, whereas HO promotes placenta development, palatogenesis and protection against abortion.

MATERIALS AND METHOD: In pregnant wild type CD1 mice at gestational day 11 (E11) SnMP (30 µmol/kg body weight) or different doses of heme at E12 (30, 75 and 150 µmol/kg body weight) and combinations were administered. All experimental groups were compared to the control group (no administration). After sacrifice of the animals at E16, foetuses and placentas were isolated and screened for morphological abnormalities.

RESULTS: No foetal resorptions were found in controls or after administration of SnMP. On the other hand, significantly more foetal resorptions were found after administration of heme 30 and 75 µmol/kg body weight, and SnMP and heme 30 µmol/kg body weight. Total foetal abortion was found after administration of heme 150 µmol/kg body weight and the combination SnMP and 75 µmol/kg body weight. A higher placenta weight was found in the SnMP group and the SnMP and heme 30 group. Furthermore, in placenta administration of SnMP and the combination SnMP with 30 µmol/kg body weight heme resulted in a significantly higher junctional/labyrinth zone ratio. Immunohistological staining showed increased expression of IL-1 β and ICAM-1 together with an influx of F4/80 positive macrophages after administration of SnMP and heme 30 group and 75 µmol/kg body weight. No abnormalities in palatal fusion were found in the foetuses that survived the different treatments.

CONCLUSION: Excess levels of heme promote foetal loss and inflammatory stress in placenta, while HO-expression protects against heme-induced abortion and excessive inflammatory insults.

OP 03 HERITABILITY OF DENTAL AND SKELETAL CEPHALOMETRIC VARIABLES IN MONOZYGOUS AND DIZYGOUUS TWINS

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AIMS: To determine the influence of genetic and environmental factors on vertical and horizontal dimensions of the craniofacial complex.

SUBJECTS AND METHOD: Fifty pairs of twins were selected [25 monozygotic (MZ) and 25 dizygotic (DZ)]. The mean age of subjects in the MZ and DZ groups was 16.2 (13.4-19.8) and 16.6 (13.8-20.1) years, respectively. This cross-sectional twin study was carried out using lateral cephalograms. The subjects were required to have passed their pubertal growth spurts and received no previous orthodontic treatment. Twenty-three linear and angular cephalometric variables were identified and measured. Heritability assessments were undertaken according to the path analysis model and also using the Holzinger's equation. For each cephalometric variable Pearson's intrapair correlation coefficients were calculated for MZ and DZ twin pairs. The estimate of heritability and coefficient of cultural heritability were then calculated for the cephalometric variables.

RESULTS: Overall vertical variables showed higher heritability than horizontal variables. The anterior cranial base (S-N), saddle angle (NSBa), total anterior face height (N-Me), lower anterior face height (ANS-Me), SNA, SNB, SNPog, gonial angle, SN-GoGn angle and SN-Maxillary plane angle showed high heritability. Heritability was low to moderate for the dentoalveolar variables.

CONCLUSION: Vertical variables, in particular total anterior face height and lower anterior face height, showed more heritability than horizontal ones. Heritability seems to be expressed more anteriorly than posteriorly. The lower third of the face seems to be under strong genetic control.

OP 04 IMPACT OF GENETICS AND ENVIRONMENTAL FACTORS ON THIRD MOLAR AGENESIS

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AIMS: To determine the impact of genetics and environmental factors on third molar agenesis in twins.

SUBJECTS AND METHOD: The study sample consisted of same sex twin pairs with normal growth and development according to human growth curves using anthropometric measures. Criteria for inclusion were: Caucasian twin pairs of the same gender, twins older than 12 years of age, no congenital anomalies or syndromes, no missing teeth, no tooth extractions, no previous orthodontic treatment and good quality pre-treatment digital panoramic radiographs. Digital panoramic radiographs were used to minimize the radiation dose following standard radiation safety principles. Every digital panoramic radiograph was evaluated by one orthodontist who had received additional training for tooth bud mineralization assessment on panoramic radiographs. The investigations were conducted twice with a 2-week interval for the evaluator's calibration. Intraexaminer reliability was assessed by means of Kappa statistics, which showed perfect agreement (Kappa for all third molar agenesis was 1). The zygosity of the twins was established using 15 specific DNA markers.

RESULTS: The study sample comprised 284 same sex twins (172 monozygotic, 112 dizygotic), whose mean ages were 19.7 ± 4.3 and 18.9 ± 4.8 years, respectively. The monozygotic group consisted of 36.3 per cent males and 63.7 per cent females, while the dizygotic group consisted of 50.1 per cent males and 49.9 per cent females. The prevalence of third molar agenesis in monozygotic twins was 19.6 per cent, which was higher than in the dizygotic twins group (15.50%; $P = 0.004$). In both groups, third molar agenesis was more frequent in the maxilla than in the mandible ($P = 0.000$). Agenesis of the maxillary third molars was mostly affected by additive genetic factors (62-63%), with the common environment and the specific environment accounting for up to 25 and 13 per cent, respectively. In contrast, agenesis of the lower third molars was associated with a higher additive genetic determination (81-83%), with the specific environment accounting for 17 to 19 per cent.

CONCLUSION: The formation of the follicle of the third molar is strongly controlled by genetic factors.

OP 05 ELICITING ADOLESCENT AND PARENT PREFERENCES FOR HYPODONTIA CARE

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AIMS: Hypodontia often requires choosing between complex treatments where there is no single 'best' treatment. To support shared decision-making and selection of the most appropriate treatment, it is important to understand patient and family preferences. This study aimed to

examine current decision-making processes and elicit adolescent-parent preferences for hypodontia care.

MATERIALS AND METHOD: Stage One: Examination of decision-making and identification of important factors in hypodontia care: 1) Systematic literature review methods (n = 56); 2) Analysis of patient information resources (n = 30); 3) Naturalistic observation and analysis of clinical consultations (n = 5); 4) Interviews with adolescents and parents (n = 16); 5) Content analysis of public posts on social media (n = 247). Stage Two: Design and testing of a discrete choice experiment (DCE) survey: 1) Application of design theory and best practice guidelines; 2) Stakeholder consultation; 3) Piloting (n = 20) using cognitive interviewing alongside statistical analysis of preference data; 4) Finalisation of DCE survey. Stage Three: Elicitation of adolescent-parent preferences for hypodontia care: 1) UK-wide online DCE survey to measure population-level preferences (n = 200); 2) Face-to-face DCE survey to observe individual and joint preferences (n = 30).

RESULTS: Issues were identified in the decision-making process for hypodontia: poor adolescent and parent knowledge about hypodontia and treatment, inadequate professional awareness of shared decision-making, low patient engagement and few tools for incorporating patient preferences into decisions. Important components of hypodontia care for decision-making related to service delivery and treatment outcome. Attributes included in the DCE were: wait for treatment, risk of problems, quality of life during treatment, treatment duration, appearance and bite after treatment. These were presented in varying combinations in seven hypothetical scenarios as a paired-choice to elicit preferences. 'Improved appearance' and 'Risk of severe problems' were significantly important attributes for decision-making. There was a difference in preferences between adolescents and parents. Observation of joint adolescent-parent decision-making suggested three dynamics: parent-led, adolescent-led, and mutual negotiation. Respondents reported that completing the DCE survey encouraged consideration of preferences and promoted greater discussion.

CONCLUSION: Addressing issues identified in shared decision-making is essential to driving improvements in care. Encouraging adolescents and parents to think and talk about their preferences and incorporating these into decision-making can improve satisfaction with treatment choices.

OP 06 DENTAL AGENESIS IN COMPLETE UNILATERAL AND BILATERAL CLEFT LIP AND PALATE PATIENTS INSIDE AND OUTSIDE THE DEFECT AREA

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AIMS: To evaluate the prevalence and distribution pattern of dental agenesis inside and outside the cleft area in an Italian population affected by a non-syndromic unilateral and bilateral cleft lip and palate.

MATERIALS AND METHOD: Two hundred and thirty three digital panoramic radiographs of patients between 6 and 15 years of age. The patient sample included 151 males and 82 females according to the following inclusion criteria: unilateral (UCLP) or bilateral cleft lip and palate (BCLP), no other syndromes, no previous orthodontic treatment, no previous tooth extractions and a good quality of digital panoramic radiographs. The analysis was independently performed by two experienced orthodontists, and, in case of disagreement, consensus was achieved by consulting a third practitioner. The total sample size was checked by appropriate statistical calculations. Statistical analyses were carried using Chi-squared test setting a *P* value lower than 0.05.

RESULTS: One hundred and sixty subjects out of 233 (68.67%) had agenesis of at least one permanent tooth. The prevalence of hypodontia was significantly more frequent in BCLP than UCLP patients with a total of 153 missing teeth (51.34%). The most frequently missing tooth was the lateral incisor, followed by the upper second premolar and the lower second premolar. No difference related to gender and side of the unilateral cleft was found. A statistically significant difference was found between unilateral and bilateral clefts for both maxillary and mandibular dental arches with BCLP patients presenting more dental agenesis.

CONCLUSION: BCLP patients presented an increased prevalence of tooth agenesis in both the upper and lower dental arches. The higher prevalence in the maxillary dental arch can be explained by the cleft defect. The results for the mandibular arch cannot be explained by the anatomical defect and reinforce the idea of a genetic aetiology of the cleft condition.

OP 07 ASSOCIATED CONGENITAL MALFORMATIONS AND SYNDROMES IN PATIENTS WITH CLEFT LIP AND/OR PALATE

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AIMS: To analyse the potential involvement of heredity of cleft lip and/or palate (CL/P) by monitoring patients and their families. A potential association of orofacial birth defects with other congenital anomalies and syndromes should support the comprehensive examination of these patients in treatment centres.

SUBJECTS AND METHOD: Two hundred and twenty six patients with CL/P were recruited. The patients responded to a standardized questionnaire. Additionally, the pedigree of the patients was verified by a personal interview with the family members and compared to the patient file.

RESULTS: CLP shows the largest category with 57.9 per cent patients, followed by CP with 25.2 per cent and 12.8 per cent CL with or without alveolus. A family history was found in 70 (26.6%) of the 263 registered siblings. Thirty nine (61.9%) of the 63 non-syndromic patients with a positive pedigree were male and 24 (38.1%) female. Eight individuals of the 70 patients had additional syndromes. Affected relatives could be detected in 29.4 per cent of patients with CL and/or CL/P, in 28.6 per cent with CL/P and in 11.9 per cent with hard and/or soft palate clefts.

CONCLUSION: Several gene mutations are known which potentially cause and respectively increase the risk for the development of CLP. The findings of this study support this assumption of a positive correlation in family history. Further studies are necessary and will help to understand the molecular mechanisms for cleft development. For this approach specific gene mutation analysis, gene expression and epigenetics, and systems biology must be coordinated.

OP 08 GENETIC STRATEGY IN MULTIDISCIPLINARY TREATMENT IN CLEFT LIP AND PALATE

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AIMS: To prevent the occurrence of obstructive sleep apnoea (OSA) in unilateral (UCLP) and bilateral cleft lip and palate (BCLP) patients demonstrating a high correlation of genetic markers for OSA.

SUBJECTS AND METHOD: The prospective non-randomized cohort study involved 114 patients with UCLP and BCLP treated according to an approved protocol for 7 years. Morphometric evaluation was carried out on three-dimensional upper and lower dental models before and after active nasoalveolar moulding (NAM), after primary cheiloplasty, before palatoplasty and at 4 and 7 years of age. After lip repair surgery during 7 years all the patients used fully individualized nasal stents. To assess the effects of nasal stent application, computer tomography was performed and volumetric geometric models of the nasal cavity were made to calculate nasal airflow. A paired *t*-test, ANOVA and logistic regression were applied to describe quantitative values. Genes methylation analysis and genetic markers expression were implemented to define the risk of OSA.

RESULTS: Long-term effects of NAM and further active orthodontic treatment were excellent as the upper arch form coincided with the lower arch. Longitudinal nasal stent application led to equalization of the airflow in both nasal passages since the stents prevented narrowing of the nasal passages and scar tissue deformation. The nasal cavity volume, and especially posterior cavity area, increased in UCLP and BCLP after the age of 4.5 years. Genetic predictors of OSA were defined. A statistically significant correlation among decreasing SP140 expression, IL1R2 gene and hypoxia development was determined.

CONCLUSION: Despite the high genetic risk of sleep apnoea and excessive daytime sleepiness in UCLP and BCLP, OSA did not occur epigenetically due to the treatment undertaken.

OP 09 TREATMENT OF INFANTS WITH SYNDROMIC ROBIN SEQUENCE WITH THE TÜBINGEN PALATAL PLATE – A MINIMALLY INVASIVE TREATMENT OPTION

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AIMS: Robin sequence (RS) involves the triad of micrognathia, glossoptosis and respiratory distress. Infants with syndromic RS suffer from more severe upper airway obstruction (UAO) and feeding problems than those with isolated RS. The aim was to investigate whether the treatment concept for isolated RS, consisting of a palatal plate with a velar extension (Tübingen Palatal Plate; TPP) shifting the tongue into a more anterior position and functional treatment, is also effective in children with syndromic RS.

MATERIALS AND METHOD: A retrospective chart review of all children admitted with syndromic RS over a 7 year period was carried out. UAO was quantified by cardiorespiratory sleep studies performed before and during TPP treatment. Obstructive sleep apnoea (OSA) was defined as a mixed OSA index (MOAI) >3/hours. Feeding modalities and weight gain, determined as Structural Disruption Scores were also evaluated.

RESULTS: Of 68 children meeting inclusion criteria, 56 completed treatment and 46 of them were younger than 12 months. Underlying diagnoses included craniofacial dysostosis (N = 13) and synostosis syndromes (N = 5), unspecified dysmorphic syndromes (N = 23) and miscellaneous rare conditions (N = 27). Median MOAI decreased from 8.5 (range 0.3-76.0) at admission to 1.1 (0.0-5.2) at discharge ($P < 0.001$). Fifty one children received only a TPP and five additional respiratory support (e.g. continuous positive airway pressure) during sleep for mild residual OSA. Three children who underwent a tracheostomy before admission had their tracheostomy closed with the TPP. The number of exclusively gavage fed infants was reduced from 23 to 7. Conversely the number of children fed only by mouth increased from 18 to 30. Median SDS for weight improved from -1.6 (-3.5-1.7) to -1.3 (-4.1-2.5). Twelve infants had TPP treatment prematurely discontinued for different reasons (e.g. laryngeal collapse/laryngomalacia, central sleep apnoea only, severe respiratory distress unresponsive to TPP, treatment refusal by parents). Three ultimately underwent tracheostomy. None of the patients died during treatment.

CONCLUSION: Treatment of UAO and feeding problems in children with syndromic RS by TPP was shown to be effective, safe and only minimally invasive. If confirmed in prospective studies, it may help to avoid more invasive interventions.

OP 10 THREE-DIMENSIONAL SKELETAL AND AIRWAY CHANGES IN CLEFT PATIENTS WITH A CLASS III MALOCCLUSION TREATED WITH BONE ANCHORED MAXILLARY PROTRACTION: A 3.5 YEAR FOLLOW-UP

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AIMS: To evaluate, in a prospective controlled trial, the long-term skeletal and airway changes of bone anchored maxillary protraction (BAMP) in growing cleft patients with a Class III malocclusion using three-dimensional (3D) surface models and two-dimensional (2D) lateral cephalograms derived from a cone beam computed tomographs (CBCT).

SUBJECTS AND METHOD: Sixteen children (11.5 ± 0.5 year) with a complete unilateral cleft lip and/or palate and a Class III malocclusion (ANB angle $< 0^\circ$ and/or Wits < 0 mm) were included. CBCT scans were taken before the start of BAMP (T0) and after 3.5 years of treatment (T2). The latest included scans were made in October 2018. 3D skeletal changes were measured of STL surface models using a colour mapping method. Cephalometric measurements were made on lateral cephalograms derived from the CBCT scans. The total airway volume was divided by the nasopharynx, middle- and inferior pharynx. The volume was calculated using the 'measure cube' tool in the CBCT software, Romexis. All measurements were performed twice by two observers.

RESULTS: Interobserver agreement of all measurements was high (intraclass correlation coefficient = 0.847). Significant skeletal changes were observed in the midface region. A total forward displacement of 2.9 ± 1.3 mm was observed in the maxilla and a total displacement of 3.6 ± 1.4 mm on the zygomas (2.7 mm forward, 1.4 mm downward and 1.5 mm outward). The mandible moved 2.5 ± 2.0 mm forward but only 0.3 mm downwards. On the lateral cephalograms SNA and ANB angle changes significantly compared to T0 (1.7° and 1.3°), and the Wits value increased significantly by 1.7 mm. No vertical skeletal changes were observed. An average overjet increase of 3.5 mm was obtained. Concerning airway volume, all subdivisions increased significantly, with an average total volume increase of 2909 mm³. The nasopharynx increased relatively the most.

CONCLUSION: This 3.5 year follow-up study shows that BAMP therapy in cleft children with a Class III malocclusion is a clinically effective and stable treatment option without impeding airway volumetric development.

OP 11 DO INFANT CLEFT DIMENSIONS AND TIMING OF HARD PALATE CLOSURE AFFECT PALATAL MORPHOLOGY IN UNILATERAL CLEFT LIP AND PALATE PATIENTS?

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AIMS: To describe palatal dimensions and morphology in unilateral cleft lip and palate (UCLP) patients who received early (12 months) or delayed hard palate closure (DHPC at 36 months), in relation to non-cleft controls. Initial cleft severity was considered in the analysis.

MATERIALS AND METHOD: This was a single centre-controlled subgroup analysis within a randomised controlled trial (RCT) of primary surgery. A total of 122 plaster models of UCLP subjects included in a primary palatoplasty RCT, comparing early versus DHPC, were digitized. Linear measurements of palatal height and width were performed on 116 digital models (mean age 8 years) and compared to a control group (28 models). A novel three-dimensional (3D) method was applied, and morphological differences visualized through colour mapping. The mesh to mesh distances between the 3D cleft palate subjects and controls subjects were calculated and differences between the groups assessed.

RESULTS: UCLP palates were higher than controls at the level of the anterior scar ($P = 0.002$) but lower in the middle region ($P < 0.001$). The group who received DHPC presented a flatter palate posteriorly ($P = 0.048$). Early hard palate closure induced more transversal constriction ($P = 0.003$). 3D analysis revealed that the central palate after DHPC was shallower both in the middle ($P = 0.002$) and posteriorly ($P = 0.008$). When adjusting for infant cleft size, an anterior cleft plays a role in determining palatal height ($P = 0.029$; .010).

CONCLUSION: DHPC favours palatal width but seems disadvantageous for palatal height. Infant cleft dimensions partially explain differences in palatal height.

OP 12 IS THERE A RELATIONSHIP BETWEEN NASAL CHANGES AND PATIENTS' PERCEPTIONS AFTER LE FORT I SURGERY?

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AIMS: To evaluate the effects of maxillary surgery on the nose and the correlation between cephalometric measurements and patient's perception of nasal changes in Class III patients who underwent a Le Fort I osteotomy

SUBJECTS AND METHOD: Eighty-five patients who underwent orthognathic surgery with maxillary impaction and/or only maxillary advancement were included in this study. Lateral cephalometric radiographs were taken before and at the end of the treatment and a total of 22 parameters were analysed with Dolphin Imaging software. The patients were given an aesthetic evaluation form and asked to evaluate their noses on the Likert scale, while at the same time they were asked to evaluate their profile silhouettes without knowing that it was their own. Any correlation between skeletal maxillary movement, the soft nasal tissues and the aesthetic evaluation points were analyzed with Pearson's and Spearman's correlation analysis. An independent samples *t*-test and Mann-Whitney *U*-tests were used to evaluate the differences in the soft nasal tissues between group 1 (maxillary advancement) and group 2 (advancement plus impaction).

RESULTS: Post-operative nasal tip inclination and rotation, nasofacial angle and sagittal movement of pronasale (Prn-VR) increased significantly; nasal tip protrusion, nasofrontal angle and vertical movement of pronasale (Prn-HR) values decreased ($P < 0.05$). The nasolabial angle, nasal tip rotation and Prn-HR distance between the pre- and post-operative period showed a significant difference between the two surgical groups ($P < 0.05$). At the end of treatment, a significant increase was observed in the patients' objective nasal aesthetic scores ($P < 0.05$). According to the results of the questionnaire, no significant difference between subjective and objective post-operative nasal aesthetic perception were observed.

CONCLUSION: Nasal tip is affected by the vertical and sagittal surgical movements of the maxilla and a moderate positive correlation was found. The vertical movement of the nasal tip, the nasolabial angle and the facial convexity angles differed significantly between groups 1 and 2. There was moderate correlation between a patient's perception of nasal change and cephalometric measurements after orthognathic surgery. The subjective level of self-admiration of the nose among individuals was similar after surgery, finding their noses to be statistically more aesthetic in an objective evaluation.

OP 13 RETROSPECTIVE INVESTIGATION OF ALAR BASE CINCH SUTURE EFFECTS ON LONG-TERM NASOLABIAL ANGLE CHANGES FOLLOWING MAXILLARY OSTEOTOMY

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AIMS: Le Fort I osteotomies have been associated with an increase in alar base width, which is often undesirable. Surgical adjuncts such as the alar base cinch suture have been created to counteract this change. A possible consequence of the cinch suture is an unwanted increase in nasolabial angle. This investigation aimed to assess the changes to the nasolabial angle following a Le Fort I osteotomy with and without the use of the alar base cinch suture immediately post-operatively, at 6-12 months post-operatively and more than 12 months post-operatively.

SUBJECTS AND METHOD: One hundred and seventy five patients who had undergone a maxillary osteotomy were identified (106 females: 69 males, age range: 16-45 years). After applying the inclusion and exclusion criteria, 78 patients were eligible for the study. Pre-operative, immediately post-operative (0-4 weeks) and long-term follow-up lateral cephalograms were traced and the values of the upper component, lower component and overall nasolabial angle were measured. Clinical significance was set at 4 degrees.

RESULTS: Fifty one patients had a cinch suture placed and 27 patients did not. There was no difference between the groups for age, mean maxillary impaction and advancement. There were statistically more females in the cinch group compared to no cinch. Intrarater testing showed almost perfect agreement. The overall nasolabial angle and upper component increased significantly in the cinch group immediately post-operatively (median increase in angle of 4.5°; $P = 0.006$) and 7°; $P < 0.001$, respectively). This increase had resolved at the 6-12 month follow-up for the overall angle and by the 12+ month follow-up for the upper component. The lower component reduced by a median of 3.5 degrees but this was not deemed statistically significant. There were no significant changes in the no cinch suture group.

CONCLUSION: In the short-term, an alar base cinch suture increases the upper component and overall nasolabial angle with respect to pre-operative values. In the long-term (more than 12 months), these changes resolve suggesting the cinch suture does not impact on the nasolabial angle.

OP 14 CLOSED VERSUS OPEN SURGICAL EXPOSURE OF PALATALLY DISPLACED CANINES: ERUPTION TIME, COMPLICATIONS AND PATIENT PERCEPTIONS; A RANDOMIZED CONTROLLED TRIAL

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AIMS: This randomized controlled trial tested the null hypothesis that there are no differences in the outcomes associated with closed and open surgical exposure protocols in subjects with palatally displaced canines (PDC).

SUBJECTS AND METHOD: One hundred and nineteen patients with mean age 13.4 years (SD 1.5 years), who had uni- or bilateral PDCs planned for surgical exposure, were included consecutively from three orthodontic centres in Sweden. After informed consent, the participants were randomly allocated to one of the two surgical interventions. A full-thickness mucoperiosteal flap was raised, and bone covering the canine was removed in both interventions. In the closed exposure an attachment with a chain was bonded to the canine and the flap was sutured back with the chain penetrating the mucosa. In open exposure a window of tissue around the tooth was removed and glass ionomer cement placed on the canine crown, to prevent gingival overgrowth during

spontaneous eruption. The participants answered questionnaires every third month, for assessment of their experience of pain and discomfort during the eruption phase. The duration of the eruption phase was measured from the operation day until the canine was visible with $-\frac{1}{2}$ of the crown. An independent *t*-test was used for continuous variables and a Mann Whitney *U* test for categorical data.

RESULTS: Eruption time was significantly shorter in the open group, at 264 days (SD 136), compared to 340 days (SD 167) in the closed protocol ($P = 0.008$). Complications such as re-exposure were more common in the open group than in the closed group, due to gingival overgrowth or loss of glass ionomer. Primarily the results suggest no significant differences in patients' perceptions during the eruption phase.

CONCLUSION: PDCs erupted a mean of 2.5 months faster in the open than in the closed surgical exposure group. The need for re-exposure was more common in the open than in the closed exposure group during the eruption phase.

OP 15 AESTHETIC OUTCOME OF AUTOTRANSPLANTATION OF PREMOLARS TO THE ANTERIOR MAXILLA

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AIMS: The literature contains little evidence concerning the aesthetic outcome of premolar transplantations to the incisor region, especially using an objective scoring system. Therefore, the aim of this study was to evaluate the long-term aesthetic outcome of transplanted premolars to the maxillary incisor region with both an objective and a subjective scoring method.

MATERIALS AND METHOD: Eighty-two single premolars autotransplanted to the maxillary incisor region were evaluated after a mean observation period of 4.6 years (range, 1-25 years). The material was obtained from two centres: Ghent University Hospital and Proclin Rotterdam. Twenty-four premolars had an open apex (immature teeth) at the time of transplantation, while 56 premolars had (almost) completed their root development (mature teeth). Patient records comprised clinical parameters, standardized radiographs, and an aesthetic evaluation from photographs using the White Esthetic Score (WES) and Pink Esthetic Score (PES). Twenty-five patients completed a questionnaire using visual analogue scales (VAS) to register their opinion about the treatment and its outcome. Categorical variables were compared using χ^2 or Fisher's exact test, and relative risk ratios and risk differences were calculated. Statistical significance was assumed at the 5 per cent level.

RESULTS: Concerning aesthetic evaluation of the surrounding soft tissues, 18.8 per cent were aesthetic failures (PES <6), 66.7 per cent were aesthetically acceptable, and 14.5 per cent were aesthetically (almost) perfect (PES <9). For WES, 24.7 per cent were considered unfavourable (WES <6), 67.1 per cent demonstrated acceptable aesthetics, whereas 8.2 per cent showed a (almost) perfect outcome (WES <9). A statistically significant correlation was found between WES and the position of the transplanted premolar at the receptor site (90° rotation or no rotation). The estimated probability of success in this sample was 2.4 larger when the transplanted premolar was not rotated. No significant correlations between PES or WES and other clinical parameters could be found. The patients generally responded favourably regarding their perception of treatment and the aesthetic results.

CONCLUSION: The overall status of the transplanted premolars and surrounding tissues indicated that the aesthetics of a premolar transplanted to the upper incisor region are mostly acceptable and often (very) satisfying. Patients' perceptions of the surgical management and the final treatment outcome were favourable.

OP 16 COMPARISON OF CLINICAL EFFECTS OF ORTHODONTIC TREATMENT USING LABIAL AND LINGUAL SELF-LIGATING BRACKETS

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AIMS: To clinically compare the effects of labial and lingual self-ligating brackets on periodontal tissues, the time elapsed for levelling and aligning of mandibular incisors and dental arch changes.

SUBJECTS AND METHOD: Twenty individuals (aged 18-30 years) randomly divided into two groups. In the labial group, Empower 2® (American Orthodontics, Sheboygan, Wisconsin, USA) self-ligating brackets were used and in the lingual group Harmony® (American Orthodontics) customized self-ligating brackets were placed. Before treatment, at the end of the first month of treatment and at the end of the levelling phase, clinical periodontal parameters including periodontal probing depth (PPD), plaque index (PI), and bleeding on probing (BOP) were measured. The time elapsed for levelling and aligning of the lower incisors of individuals in the both groups was calculated in days. Digital models were generated from plaster models which were scanned with a three-dimensional model laser scanner (3Shape D710; 3Shape A/S, Copenhagen, Denmark). The digital models were analyzed using 3Shape Orthoanalyzer software program (3Shape A/S). Normal distribution of numerical variables was evaluated by Shapiro Wilk normality test and Q-Q graphs. Intergroup evaluation for single variables was assessed by an independent samples *t*-test. Comparison of the groups according to time was evaluated by repeated two-way analysis of variance and generalized linear models. The Bonferroni test was used for multiple comparisons. Statistical significance level was established at $P < 0.05$.

RESULTS: PI and BOP values were significantly higher in the labial group at the first month of treatment ($P < 0.05$). When PPD was evaluated, no significant difference was found between the two groups. The duration of levelling and aligning of mandibular incisors was statistically lower for the lingual group ($P < 0.05$). When the dental model analysis was evaluated, no significant difference was found between the groups. However, there was an overall increase in dental arch parameters after the levelling phase in the labial group.

CONCLUSION: Lingual self-ligating brackets offer a significant advantage over labial self-ligating brackets with regard to the duration of levelling and aligning.

OP 17 COMPARATIVE ASSESSMENT OF FULLY CUSTOMIZED LINGUAL APPLIANCES AND LABIAL BRACKET SYSTEMS: AN EXPERIMENTAL INVESTIGATION

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AIMS: To determine forces and torques as well as the effectiveness of tooth movement in different fully individualized lingual bracket systems compared to labial brackets on a patient-individualized malocclusion model.

MATERIALS AND METHOD: Fully customized lingual brackets of two brands were examined: Incognito™ (3M Unitek, Monrovia, Minnesota, USA) and WIN (DW Lingual Systems, Bad Essen, Germany). The labial Discovery classic and Discovery smart bracket systems (Dentaurum, Ispringen, Germany) were used for reference. Six identical resin models were constructed from the initial malocclusion model. From each model, the tooth under examination was removed and replaced with a sensor. Three teeth were examined [a lateral incisor (42), a canine (33) and a premolar (45)]. The models were bonded with brackets according to the templates received from each laboratory. The orthodontic measurement and simulation system was used for experimentation. In total, four types of wires were examined and each measurement was repeated five times, each time with a different piece of the same type of wire, to test manufacturing accuracy. Simulated levelling was performed, with an archwire change as soon as forces or torques were no longer effective. Mean values and standard deviations of the following parameters were calculated: initial forces, torques and achieved error correction. For the statistical analysis *t*-tests and ANOVA were performed.

RESULTS: In general forces ranged between 0.01 and 4.06 N for all bracket types, while moment values ranged between 0.16 and 23.07 Nmm. The maximum forces and moments were generated during simulated levelling with the lingual appliances in a direction consistent with the malocclusion type of the tooth under examination. In most cases labial bracket systems produced lower force values in comparison with lingual appliances irrespective of the wire type used. Differences between the two lingual appliances were also observed.

CONCLUSION: Different bracket-wire combinations can produce divergent forces and moments during alignment of the same malocclusion model. Higher values were recorded during alignment with the lingual systems.

OP 18 ASSESSMENT OF CLASS II CORRECTION BY MAXILLARY DISTALIZATION WITH CUSTOMIZED LINGUAL APPLIANCES USING CORTICAL ANCHORAGE DEVICES***

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AIMS: To evaluate distalization with temporary anchorage devices (TADs) placed in the alveolar process; the null hypothesis that there would be significant a difference between the canine relationship on the target-set-up-model (treatment plan) and the treatment outcome was tested.

SUBJECTS AND METHOD: Sixteen consecutively debonded subjects [14 females, 2 males, age at the start of treatment (T0) 13.3 to 43.8 years; mean age 28.5 years (standard deviation (SD 11.0))] were included in this retrospective analysis. The inclusion criteria were treatment completed with a completely customized lingual appliance (CCLA) in combination with TADs for uni- or bilateral maxillary distalization. A total of 26 quadrants (six unilateral, 10 bilateral) were assessed on the target set-up models, on plaster casts and intra-oral photographs scaled to the plaster casts, at T0, TAD insertion (T1), and debonding (T2). A paired *t*-test ($P = 0.05$) was used to test significance.

RESULTS: The mean disto-occlusion of the canines in the TAD quadrants was 3.9 mm (SD 1.7) at T0, 4.6 mm (SD 1.3) at T1, and 0.3 mm (SD 0.6) at T2. The planned canine relationship on the target set-up was 0.1 mm (SD 0.3). The null hypothesis was rejected as there was no significant difference between the planned (target set-up) and the achieved canine relationship ($P > 0.05$); 96 per cent of the correction was achieved.

CONCLUSION: Class II correction with a CCLA in combination with TADs for maxillary distalization can be a predictable treatment option.

OP 19 UPPER INCISOR ROOT TORQUE DURING SPACE CLOSURE AND CLASS II CORRECTION IN CLASS II DIVISION 2 PATIENTS WITH GENERALIZED SPACING

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AIMS: It is difficult to achieve normal root torque of upper incisors in Class II division 2 cases during space closure. This study investigated upper incisor position using a completely customized lingual appliance (CCLA); biomechanically Class II elastics and elastic chains were used. The null hypothesis theorized no significant difference between the centre of rotation (CROT) and the centre of resistance (CRES) during space closure.

SUBJECTS AND METHOD: In this retrospective study, 29 consecutive patients received CCLA treatment. Maxillary incisor root inclination was assessed cephalometrically at the beginning (T1) and end (T3) of CCLA treatment. The incisors' CROT was assessed by the point of intersection of the incisor axes (T1, T3). CRES at was defined as 36 per cent of the incisor apex-incisal edge distance. For pure torque movement of the root, the CROT was defined at 55 per cent of this distance, which is at the level of the alveolar crest. The potential difference between the CROT and CRES was analysed using a non-parametric sign test and the significance level was set to $P = 0.005$.

RESULTS: At T1, the mean total maxillary spacing was 3.0 mm (SD 1.9; range 1 to 10 mm). At T3, all spaces were closed. Sagittal distal occlusion improved from a mean of 4.5 mm following levelling and aligning (T2; SD: 1.1) to a mean of 0.2 mm (SD: 0.3) at T3. The null hypothesis was rejected: the mean CROT was at 88.6 per cent of the incisor's apex-incisal edge-distance which represents the upper third of the crown and indicates a movement of root torque. This difference was found to be statistically significant ($P < 0.001$).

CONCLUSION: CCLA are able to create upper incisor palatal root torque even in cases where lingual forces below the CRES of the roots (such as Class II elastics and elastic chains) and counteract this movement.

OP 20 BREAKAGE RATE OF A FULLY CUSTOMIZED LINGUAL APPLIANCE: A RETROSPECTIVE STUDY

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AIMS: Because most lingual appliances are customised on a set-up model, bonding is usually indirect. Successful bonding is crucial to the success of lingual treatment. Breakages can be time consuming as the brackets must be rebonded in the correct position based on the set-up otherwise

finishing can be time consuming and results can be compromised. Customised lingual appliances offer a large bonding base claiming to improve bonding and rebonding success. The appliances also allow a variety of bracket designs such as regular lingual pads, brackets bases that cover half of the occlusal surface, termed half occlusal pads, as well as full coverage crowns or bands for posterior teeth. This was a retrospective study aiming to evaluate the breakage rate of the fully customized lingual appliance Incognito (3M Unitek).

SUBJECTS AND METHOD: Eighty two consecutively treated patients. For inclusion the cases would have had to be started and completed following the same indirect bonding protocol with a dual cured resin cement. Transfer cases were excluded. The records were examined for all unscheduled and scheduled repair or emergency appointments throughout the treatment duration.

RESULTS: There was an overall failure rate of 2.8 per cent of bonded brackets. When age was considered, adolescent patients (12-18 years old) had a higher breakage rate of 4.5 per cent while adults 19+ years showed a 2.6 per cent breakage rate. When bracket design and region of the mouth was taken into consideration lingual brackets with no occlusal coverage and regular pads on the posterior teeth accounted for 60 per cent of the failures, casted crowns on posterior teeth for 10 per cent and anterior teeth 29 per cent, while posterior teeth with half occlusal coverage (half occlusal pads) accounted for less than 1 per cent. Additionally the study showed that repair appointments due to sharp wires were 50 per cent less common in adolescent patients

CONCLUSION: The breakage rate of the Incognito customized lingual appliance was clinically acceptable. The breakage rate of posterior teeth can be significantly reduced if half occlusal pads are incorporated into the bracket design. Adolescent patients had more breakages but less sharp wire emergency appointments.

OP 21 PREFABRICATION OF FIXED LINGUAL RETAINERS BEFORE DEBONDING OF LINGUAL FIXED APPLIANCES USING DIGITAL IMPRESSIONS: AN *IN VITRO* STUDY

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AIMS: To test a method for bending fixed lingual retention wires before debonding in lingual orthodontic patients using pre-treatment and pre-debonding digital impressions and best-fit registrations *in vitro*.

MATERIALS AND METHOD: This *in vitro* study included eight sets of pre- and post-fixed orthodontic treatment maxillary and mandibular models. Lingual orthodontic brackets were bonded on the post-treatment models using dental wax. Pre- and post-treatment models were scanned with an intraoral scanner. On the virtual models, pre-treatment anterior teeth were isolated and moved to the post-treatment positions using best-fit registrations of the incisal and labial surfaces. Virtual retention wires were designed on the resulting alignments using computer aided design software. Stainless steel wires, 0.0195 inch, were manually bent to overlap the technical drawings. The retention wires were fixed on the post-treatment models using dental wax. The models were scanned again with the bonded wires for accuracy evaluation. Deviations between the design and final position of the retention wires were calculated using an inspection software.

RESULTS: Bending of the retention wires is possible with the proposed method with reasonable success. Among the investigated 96 teeth, 81 had visually confirmed physical contact with the retainer wires. Although some of the retainers needed extra minor adjustments, these seemed acceptable. The mean absolute deviations were 0.27 mm for mesiodistal, 0.33 mm for incisogingival, 0.33 mm for labiolingual, 1.14° for roll, 0.98° for yaw and 2.75° for pitch dimensions. Standard deviations were 0.39 mm, 0.4 mm, 0.31 mm, 1.55°, 1.21° and 3.23°, respectively

CONCLUSION: Computer aided impressions and design can be used in the preparation of lingual retention wires in advance for lingual orthodontic patients. This method seems to have the potential to reduce chair time (or the waiting time) in the debonding sessions of fixed lingual appliances.

OP 22 COMPUTER-AIDED INDIRECT BONDING VERSUS DIRECT BONDING: COMPARISON OF BONDING TIME, IMMEDIATE FAILURES AND COST-MINIMIZATION ANALYSIS

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AIMS: To compare, in a randomised clinical trial, the time for bonding and immediate debonding using either direct bonding or computer-aided indirect bonding; and to perform a cost-minimization analysis (CMA).

SUBJECTS AND METHOD: Consecutive patients selected for full fixed appliance according to treatment need, were enrolled and randomly allocated to a split-mouth design with a direct and a computer-aided indirect bonding method. The main outcome was a difference in the time spent for bonding. The secondary outcome was the immediate failures. Indirect bonding time was recorded in two steps: digital bracket placement and clinical bonding procedure. Analysis of variance was used to assess differences in bonding time. A Chi-square test was used to compare immediate debondings. CMA was undertaken.

RESULTS: Fifty-one patients (mean, 16.9 years) were randomized in a 1:1 ratio to either group 1 (upper right and lower left quadrants: indirect bonding - upper left and lower right quadrants: direct bonding) or group 2 (opposite set-up). Twenty-four patients were excluded from the study, thus 15 patients were analyzed in group 1 and 12 in group 2. A total of 538 brackets were bonded. Clinical chair time was significantly shorter for the computer-aided indirect bonding procedure (mean, 12 minutes 52 seconds for a half mouth) than for the direct bonding procedure (mean, 16 minutes 47 seconds for a half mouth). Considering total bonding time (mean, 28 minutes 14 seconds for a half mouth) the indirect bonding technique was more time-consuming than the direct bonding technique ($P = 0.001$). A statistically significant difference in immediate debondings was found between the two bonding methods ($P = 0.001$): there were no immediate failures with the direct bonding method, while 5.1 per cent of brackets were lost with the indirect bonding method. CMA showed that computer-aided indirect bonding was more expensive than direct bonding.

CONCLUSION: The clinical chair time for computer-aided indirect bonding was significantly shorter than for direct bonding. However, the total bonding time for computer-aided indirect, including digital bracket placement, was longer than the direct bonding time. There were significantly more immediate bracket failures with computer-aided indirect bonding than with direct bonding and computer-aided indirect bonding was more expensive.

OP 23 EVALUATING THE CLINICAL ACCURACY OF A CUSTOMIZED LABIAL PRESCRIPTION WIRE AND BRACKET SYSTEM: A RETROSPECTIVE STUDY

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AIMS: To retrospectively evaluate the clinical accuracy of a customized labial prescription wire and bracket system.

MATERIALS AND METHOD: The records of 20 consecutive patients treated with the Insignia appliance were analyzed. The digital simulated models and actual models were analyzed for finishing quality using the American Board of Orthodontics (ABO) Objective Grading System (OGS). Seven out of the eight ABO OGS criteria were scored by the principal investigator using the Orthoanalyzer® software. The secondary objectives investigated were the differences in intercanine and intermolar widths of the simulated and actual models.

RESULTS: A statistically significant difference was observed in the overall ABO OGS scores between the simulated and actual groups (7.35 versus 23.15). Statistically significant differences were observed in all components except for interproximal contacts. Overjet was the largest contributor to the difference in the observed scores. Significant differences were observed in the intermolar widths of both the maxillary and mandibular arches with a mean difference of 4.06 mm and 2.71 mm, respectively. There was no statistically significant difference observed for the intercanine widths of the mandible, while a statistically significant but non-clinically relevant difference was observed when comparing the intercanine widths of the maxilla.

CONCLUSION: The Insignia appliance was not able to fully express its programmed digital objectives after active treatment.

OP 24 OPTIMIZED PERIODONTAL REGENERATION FOR ORTHODONTIC MOVEMENT MAY YIELD REGENERATED BONE FOR ORTHODONTIC DEVELOPMENT

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AIMS: Recently, post-operative gingival recession has frequently posed a major problem in adult orthodontics. In response to this issue, guided bone regeneration (GBR) has been reported to effectively increase alveolar bone housing. However, the bones that are regenerated by GBR are denser than physiological bones, which raises concerns that such regenerated bones may result in root resorption and orthodontic tooth movement retardation. Therefore, in the present study, bones regenerated by optimized periodontal regeneration for orthodontic movement (O-PRO), were compared with bones regenerated by GBR.

SUBJECTS AND METHOD: O-PRO was used to expand the buccal bone housing of 30 orthodontic patients with thin gingival biotypes. At 6 and 12 months post-operatively, cone beam computed tomography (Sirona Orthophos XG 3D) was used to classify the bones as Type 1-4, using the Lekholm and Zarb classification. The bones that were regenerated by GBR in an identical manner were also classified and multiple comparisons performed to compare the O-PRO and GBR results.

RESULTS: At 6 and 12 months post-operatively, the bones regenerated by O-PRO were classified as Type 3-4 and Type 3-2, respectively. The bones regenerated by GBR were classified as Type 3-2 at 6 months post-operatively and Type 2-1 at 12 months. Significant differences were observed between O-PRO and GBR at both 6 and 12 months.

CONCLUSION: The bones regenerated by O-PRO were significantly more trabecular than those regenerated by GBR, suggesting that the bones regenerated by O-PRO are suitable for orthodontic movement.

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OP 25 DIAGNOSIS AND PLANNING OF ORTHODONTIC TREATMENT IN PATIENTS WITH DIFFERENT GINGIVAL BIOTYPES AND MALOCCLUSIONS

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AIMS: To improve the quality of orthodontic treatment of patients with different periodontal biotypes by increasing the informational content of diagnostic data while using clinical methods, ultrasonic scanning, cone-beam computed tomography (CBCT) and complex three-dimensional (3D) modelling.

SUBJECTS AND METHOD: Sixty patients aged 19-25 years with malocclusions were divided into two groups: 30 with a thin gingival biotype (A) and 30 with a thick biotype (B). Clinically biotype was investigated using a colourimetric probe (Colourvue biotype probe, Hu-Friedy). The thickness of the gingiva was examined using a MyLabTwice ultrasonic device (Esaote). The condition of the alveolus of all patients was assessed using CBCT. Treatment planning was carried out using the program of complex 3D-modelling (Avantis 3D) in group A.

RESULTS: According to the scanning in group A gingival thickness amounted to 0.75 ± 0.3 mm ($P < 0.005$) and in group B 1.9 ± 0.4 mm ($P < 0.005$). CBCT, in addition to the differences in bone thickness, showed that 69 per cent of group A had dehiscence and 17 per cent had fenestrations while in group B 20 per cent had dehiscence and 3 per cent fenestrations. Complex 3D modelling was used to plan movement of the tooth roots in the space of the alveolar bone in group A.

CONCLUSION: Clinical evaluation of the gingival biotype does not allow adequate planning of orthodontic tooth movements. Ultrasonic evaluation of gingival thickness leads to a degree of planning tooth movement minimizing the risk of recessions. CBCT significantly increases information about the thickness of bone structures on all surfaces. Complex 3D-modelling significantly reduces the risk of complications during orthodontic tooth movement and torque application. Integrated application of these methods allows optimization of the choice of orthodontic intervention and the limits of moving teeth and buccal inclination, to improve the efficiency of orthodontic treatment in general and to prevent damage to the periodontal structures.

OP 26 HERBST-MULTIBRACKET TREATMENT: DOES THE AMOUNT OF LOWER INCISOR POSITION CHANGE CORRELATE WITH THE DEVELOPMENT OF LABIAL GINGIVAL RESSIONS?

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AIMS: To assess a potential association between the position changes of the lower incisors (LI) during Herbst-multibracket appliance treatment and the development of labial gingival recessions (LGR).

MATERIALS AND METHOD: All Class II patients who had been treated with a Herbst appliance and subsequently with a multibracket appliance at the study centre since 1986 with available artefact-free study models as well as lateral cephalograms from before (T0) and after treatment plus ≥ 24 months of retention (T1). Lateral cephalograms were evaluated regarding LI position changes using the following variables: iiL/ML (angle between the LI long axis and the mandibular plane), ii-MLPg (distance between the LI incisal edge and a line perpendicular to the mandibular plane through pogonion), apex-MLPg (distance between the LI apex and a line perpendicular to the mandibular plane through pogonion), ii-MLii (distance between the LI incisal edge and the mandibular plane on a line perpendicular to the mandibular plane through the incisal edge). Using study models, the labial distance between the cemento-enamel junction and the deepest point of the gingival margin was measured on the labial surface of all LI and, in case of a positive value, defined as LGR. The most severe value per patient was used in the evaluation.

RESULTS: Two hundred and fifty nine patients were included and the following LI mean changes (T0-T1) occurred during a period of 58.6 ± 11.5 months of active treatment and retention: iiL/ML: $+5.8 \pm 5.76^\circ$ ($P = 0.929$), ii-MLPg: -0.13 ± 0.25 mm ($P = 0.430$), apex-MLPg: $+0.11 \pm 0.32$ mm ($P = 0.363$), ii-MLii $+0.07 \pm 0.36$ mm ($P = 0.206$). While the respective increase seen for LGR was 0.2 ± 0.53 mm; no correlation with any LI position or inclination change was found ($|R| \leq 0.2$).

CONCLUSION: No correlation between LI position changes and the development of LGR during Herbst-multibracket appliance treatment (including retention) was found.

OP 27 EVALUATION OF OCCLUSAL CHANGES WITHIN ORTHODONTIC TREATMENT

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AIMS: To investigate the effects of orthodontic treatment on occlusion and dislocation times.

SUBJECTS AND METHOD: The study material for this prospective clinical study focused on three groups of 83 individuals: a) 20 untreated individuals with a normal occlusion (Class I) as the control group; b) 30 individuals with a Class II division 1 malocclusion without extractions; and c) 33 individuals with a Class II division 1 malocclusion and extractions. Orthodontic treatment started by applying brackets to the upper and lower teeth. Extraction of the first premolars was carried out at the start of the study. Levelling and alignment were carried out at the time of distalization of the canines. Patients in the treatment groups had three occlusal analyses; at the beginning of the study (T0) and at 6 (T1) and 12 (T2) months. The control group had their occlusion and disclusion time measured by computerized occlusal analysis only at T0. T-Scan Evo System (Software Ver. 9.2, Tekscan Inc. Boston, USA) was used to record dental occlusion and disclusion times.

RESULTS: There was a significant difference between the groups with and without extractions. A significant difference between the two groups was found at T1 and T2 for MxInt-L, MxInt-R, MxInt-R, MxBite-L and MxBite-R at the 95 per cent significance level. The result for disclusion at, T2 was significant ($P < 0.05$).

CONCLUSION: It is expected that the forces generated during the occlusal phase of chewing must be harmoniously transferred to the temporomandibular joints along the mandible. Force that cannot be transferred harmoniously to the joints can lead to imbalances in the chewing system and problems in progressive situations.

OP 28 OCCLUSAL CONTACT AREA CHANGES WITH DIFFERENT RETENTION PROTOCOLS: ONE-YEAR FOLLOW-UP

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AIMS: To evaluate occlusal contact area and cast and radiograph evaluation (CRE) score changes with three different retention protocols following a one-year retention period.

SUBJECTS AND METHOD: A total of 90 patients who had acceptable final occlusion according to American Board of Orthodontics (ABO) CRE were equally divided into three groups according to the retention protocols: upper bonded retainer plus Essix/lower bonded retainer (Essix group), upper

bonded retainer plus Hawley/lower bonded retainer (Hawley group) and upper bonded retainer/lower bonded retainer (bonded retainer group). Digital models were used to assess the occlusal contact area changes following a one-year retention period. The follow-up occlusion models were once again assessed with the ABO CRE.

RESULTS: Occlusal contact areas increased significantly in the Hawley and bonded retainer groups for all teeth except the incisors. The bonded retainer group showed the greatest amount of settling but the differences with the Hawley group were statistically insignificant. Statistically significant decreases in occlusal contact areas were recorded for the Essix group except for the incisor teeth. A decrease of CRE scores was seen in the Hawley group while a statistically significant increase was recorded in the Essix group.

CONCLUSION: Both Hawley and bonded retainers allowed settling of the occlusion during the retention phase while the Essix retainer did not allow relative vertical movement of the posterior teeth. The Hawley group showed improvement of total CRE score while the Essix group demonstrated worsening.

OP 29 PREDICTIVE FACTORS FOR LONG-TERM (≥ 15 YEARS) STABILITY AFTER CLASS II TREATMENT Niko Bock, Sabine Ruf, Department of Orthodontics, University of Giessen, Germany

AIMS: To analyse post-treatment (Tx; ≥ 15 years) data of former Class II patients for possible predictive factors of long-term stability.

SUBJECTS AND METHOD: Fifty two Class II:1 and 20 Class II:2 patients treated with a Herbst-MB appliance at age 15.4 ± 1.9 years who attended a recall at age 33.7 ± 3.0 years ($=18.3 \pm 2.9$ years post-Tx). Fully stable (overjet and overbite had increased < 1.5 mm / Class I or super Class I molars and canines or unchanged occlusion) and not fully stable cases were compared for multiple pre- and post-Tx occlusal, cephalometric and general characteristics in order to identify significant ($P \leq 0.05$) differences.

RESULTS: Thirty per cent Class II:1 and 50 per cent Class II:2 were fully stable according to the abovementioned criteria. The following predictive factors ($P < 0.05$) were determined: Class II:1 = fully stable cases had no history of previous orthodontic Tx (0 versus 31%) and shorter active Tx duration (18.1 versus 21.3 months) than not fully stable cases. Class II:2 = fully stable cases exhibited a smaller pre-Tx ANB angle (3.3 versus 5.3°) as well as smaller pre- and post-Tx overbite (4.8 versus 5.8 mm and 1.8 versus 2.8 mm) than not fully stable cases.

CONCLUSION: Only few predictive factors for long-term stability after Class II treatment were determined. The differences between fully stable and not fully stable cases were, however, rather small with low clinical discriminating value.

OP 30 LONG-TERM SAGITTAL STABILITY OF THE SURGERY FIRST APPROACH FOR MANDIBULAR PROGNATHISM: A 5-YEAR FOLLOW-UP

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AIMS: To assess the long-term sagittal stability of mandibular prognathic patients treated with a bilateral sagittal split osteotomy and mandibular setback using a surgery-first approach.

SUBJECTS AND METHOD: Thirty-one consecutively treated patients (20 females, 11 males) treated with a standardised surgery-first procedure performed by a team of a single orthodontist and two surgeons were included. Subjects aged 27.7 ± 7.92 years at deband with complete and diagnostic radiographic records and a minimum of 5-years follow-up were included. Lateral cephalograms taken at initial (T0), immediately after surgery (T1), deband (T2), and 1 (T3) 3 (T4 and 5 (T5) years post-deband were traced digitally and superimposed using the cranial base method with QuickCeph®. Dimensional changes of mandibular landmarks following deband referenced to a horizontal reference plane (sella-nasion minus 7°) were compared using repeated measures analysis of variance and reported using SPSS®.

RESULTS: The T2-T5 change in sagittal position of point B and Pogonion following removal of appliances was 0.5 ± 1.5 mm and 0.3 ± 1.3 mm, respectively. No statistically significant changes in point B or Pogonion were observed at T1, T3, or T5. However, three patients (10%) experienced a clinically relevant relapse of greater than 2 mm at Pogonion.

CONCLUSION: A surgery-first approach to mandibular prognathic patients with bilateral sagittal split osteotomy shows favourable 5-year long-term sagittal stability.

OP 31 DEVELOPMENT AND VALIDATION OF A PREDICTION MODEL FOR LONG-TERM STABILITY OF EARLY TREATMENT OF CLASS III MALOCCLUSION

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AIMS: To develop and validate a prediction model to forecast long-term stability of early treatment with rapid maxillary expansion (RME) and facemask (FM) in a large sample of Class III growing patients.

SUBJECTS AND METHOD: The Brazilian Group (BG) consisted of 73 consecutively treated Caucasian Class III patients (41 females, 32 males). The mean age before treatment (T0) was 7.1 ± 1.6 years while at long-term follow-up (T1) it was 21.8 ± 3.2 years. The Italian Group (IG, validation cohort) comprised 28 consecutively treated Caucasian Class III patients (14 females, 14 males, mean age at T0 9.0 ± 1.3 years and at T1 18.2 ± 1.4 years). Cephalometric analysis was performed on lateral cephalograms at T0. Gender and cephalometric variables, chronological age, and dentition phase at T0 were used as predictors for long-term failure of treatment (concurrent presence of Class III molar relationship and/or negative overjet of at least one incisor and a Class III profile) at T1. All predictors for unsuccessful treatment in the BG were subjected to bivariate logistic regression. Only those statistically significant predictors in the bivariate logistic regression entered mixed stepwise logistic regression with $P = 0.05$ to enter and to leave. The validity of the prediction model derived from the BG was then tested on the IG.

RESULTS: The prediction model consisted of only one cephalometric variable: the angle between the condylar axis and the mandibular plane (CondAx-MP; odds ratio 1.52, 95% confidence interval 1.25-1.85, $P < 0.0001$). Failure of treatment at T1 was predicted for values of CondAx-MP at T0 greater than the cut-off value of 147.8 degrees. BG patients predicted incorrectly were three out of 22 for the unsuccessful cases and one out of 51 for the successful cases. Therefore, accuracy was 0.95, sensitivity 0.86, specificity 0.98, and positive and negative predictive values were 0.95 and 0.94, respectively. When the predictive model was applied on IG, all five unsuccessful cases were predicted correctly while only one out of 23 successful patients was predicted incorrectly.

CONCLUSION: CondAx-ML was identified as a reliable predictor for long-term stability of early Class III treatment with RME and FM.

OP32 FACIAL ASYMMETRY IN JUVENILE IDIOPATHIC ARTHRITIS PATIENTS: DIAGNOSTIC VALUE OF CLINICAL ASSESSMENT AND THREE-DIMENSIONAL PHOTOGRAPHY

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AIMS: To evaluate whether facial asymmetry determined clinically or by digital analysis of three-dimensional (3D) photography in juvenile idiopathic arthritis (JIA) patients is associated with an asymmetric affection of the temporomandibular joint (TMJ).

MATERIALS AND METHOD: Of 79 consecutive JIA patients (52 females, 27 males) with a mean age of 11.7 years (range: 6.3-17.9 years), facial asymmetry was evaluated clinically (asymmetry: yes/no), and digitally, based on 3D photographs (Vectra 3M, Canfield Scientific, New Jersey, USA). The digital photographs were mirrored, superimposed using semi-automated algorithms constructed on predefined midface landmarks, and quantitatively assessed (asymmetry ≥ 1 mm: yes/no) using an open-source software (3D slicer). Diagnosis of the affection of the right and left TMJ was based on magnetic resonance (MR) images (radiological signs of destructive process: no signs / slightly affected / heavily affected).

RESULTS: MR images demonstrated that in 40.8 per cent of the present cases the left and right TMJ were affected differently, which could lead to facial asymmetry. Facial asymmetry was found clinically in 31.7 per cent of the cases, and digitally in 50.6 per cent of the cases. Facial asymmetry, when based on clinical diagnosis, corresponded in 67.1 per cent of the cases to asymmetric TMJ involvement ($P = 0.009$), but only in 59.2 per cent of the cases, when based on digital findings ($P = 0.28$).

CONCLUSION: Based on the reported results, the assessment of facial asymmetry has little diagnostic value to predict asymmetric TMJ affection in JIA patients. The presented quantitative evaluation of facial asymmetry from 3D photographs did not seem to contribute any additional information to the clinical assessment in identifying asymmetric TMJ involvement.

OP 33 THE STABILITY OF SURGICALLY ASSISTED RAPID MAXILLARY EXPANSION: A SYSTEMATIC REVIEW

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AIMS: To determine the stability of surgically assisted rapid maxillary expansion (SARME) by evaluating the overall stability of the procedure, the effect of distractor type (tooth-borne versus bone-borne) and the influence of retainer design on post-expansion stability.

MATERIALS AND METHOD: Electronic database searches of published literature (Medline via PubMed), Ovid via Medline, the Cochrane Oral Health Group's Trial Register, Cochrane Central Register of Controlled Trials, Lilacs, BBO) and unpublished literature were accessed until January 2018. Search terms included SARME, 'stability', 'relapse', 'surgery', 'expansion' and 'maxillary expansion'. The selection criteria (PICOS) included skeletally-mature participants (>16 years) with a narrow maxillary arch with at least one of the following features: crossbite, crowding and evidence of buccal corridors when smiling; Intervention: use of SARME; Comparison: SARME versus control or other experimental group; Outcome: Stability of transverse change; and Studies: randomised clinical trials (RCTs), prospective and retrospective studies.

RESULTS: Five hundred and ten studies were identified overall and 17 were included (4 RCTs, 2 prospective and 11 retrospective) following initial screening and data extraction of full texts. The quality of evidence was measured using the Cochrane Risk of Bias tool for RCTs and the Newcastle-Ottawa Scale for prospective and retrospective studies. These studies were either of high risk of bias or low quality and the results were therefore synthesised qualitatively. Dental and skeletal changes appear to be stable and predictable with dental relapse greater than skeletal. Similar skeletal expansion and relapse is achieved with tooth- and bone- borne devices with no difference in stability. Use of a transpalatal arch as a retention device does not influence the stability of expansion achieved with SARME.

CONCLUSION: SARME appears to result in stable skeletal and dental movement but the quality of the included studies precluded a meta-analysis due to the risks of bias and heterogeneity. Additional high quality trials are needed to allow more definitive conclusions.

OP 34 PREVALENCE OF AN ELONGATED STYLOID PROCESS AND EAGLE'S SYNDROME FOR THE DIFFERENTIAL DIAGNOSIS OF TEMPOROMANDIBULAR DISORDERS

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AIMS: The styloid process is a bony projection of cylindrical shape; it is elongated when it is longer than 30 mm. Eagle's syndrome is a disorder caused by an elongated or deformed styloid process or an ossified or calcified stylohyoid ligament. This condition can be confused with some other craniofacial and temporomandibular disorders. Imaging evaluation permits a differential diagnosis to identify a pathological styloid process or calcified stylohyoid ligament. There are only a few studies that evaluate the prevalence of the elongated styloid process in different populations. The aim of this epidemiological study was to investigate the prevalence of the elongated styloid process in order to consider this condition in the differential diagnosis of temporomandibular disorders.

MATERIALS AND METHOD: This was a retrospective analysis of digital panoramic radiographs of 1003 patients (452 females, 551 males, between 5 and 90 years of age) from the University's database. The styloid process length was measured using the measuring tool of Sidexis software from the point where it leaves the tympanic plate to its tip and was considered elongated when it was longer than 30 mm. Statistical analyses were performed with Chi-squared, Fisher-Killeen (median), Shapiro-Wilk and *t*-test. The test was considered significant if the *P*-value was lower or equal to 0.05.

RESULTS: Of the population, 33.40 per cent (35.61% males, 31.57% females) had radiographic images suggesting an elongated styloid process. No significant dependence of gender was found. An elongated styloid process was observed in 8.42 per cent of patients under 17 years of age, 33.33 per

cent between 18 and 35 years, 36.91 per cent between 36 and 53 years and 72.76 per cent over 54 years. A significant difference was found among the age groups ($P < 0.0001$). Elongation was noted in 56.72 per cent patients on both the right and left sides, while 43.28 per cent were elongated only on one side. No statistical significance was found between gender, age groups and the affected side.

CONCLUSION: As an elongated styloid process is reported in 33.40 per cent of the studied subjects; this condition should be considered in patients with chronic craniofacial pain.

OP 35 EVALUATION OF THE RELATIONSHIP BETWEEN TEMPOROMANDIBULAR JOINT DYSFUNCTION AND ORAL HEALTH IMPACT PROFILE IN ORTHODONTIC PATIENTS WITH DENTAL MALOCCLUSIONS

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AIMS: To evaluate the relationship between temporomandibular joint dysfunction (TMJD) and oral health impact profile (OHIP) in orthodontic patients with different dental malocclusions.

SUBJECTS AND METHOD: Six hundred and forty eight patients were randomly selected aged between 14 and 19 years. The subjects, divided into three groups, were 257 Class I (179 females, 78 males; mean age 16.93 ± 1.39 years), 269 Class II (177 females, 92 males; mean age 16.98 ± 1.34 years) and 122 Class III (73 females, 49 males; mean age 17.28 ± 1.21 years). Fonseca's questionnaire for prevalence and severity of TMJD and OHIP-14 forms were used to assess oral health-related quality of life (OHRQoL). A P value of less than 0.05 was considered significant in all statistical analyses.

RESULTS: Fonseca and OHIP-14 means of females were found to be significantly higher than males ($P < 0.05$). A statistically significant difference was observed between malocclusion groups of females and Fonseca TMJD group distributions ($P < 0.05$). However, there was no statistically significant difference between malocclusion groups of males and Fonseca TMJD group distributions ($P > 0.05$). A statistically significant difference was observed between Fonseca's questionnaire and OHIP-14 means of Class I, Class II and Class III malocclusion groups. The OHIP-14 and Fonseca's means of the Class III group were found to be significantly higher than the OHIP-14 and Fonseca's means of Class I and Class II groups ($P < 0.05$). There was also a statistically significant correlation between age values and TMJD OHIP-14 values.

CONCLUSION: TMJD ratio was found to be higher in females than males. There was a strong relationship between malocclusion and OHRQoL. The OHIP-14 and Fonseca's means of the Class III group were found to be significantly higher those of the Class I and II groups.

OP 36 IMPACT OF POST-ORTHODONTIC DENTAL OCCLUSION ON MASTICATORY PERFORMANCE

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AIMS: Detailing of dental occlusion remains an important stage of orthodontic treatment in spite of the limited information on whether good finishing leads to higher masticatory performance. This study aimed to evaluate the impact of post-orthodontic dental occlusion on masticatory performance.

SUBJECTS AND METHOD: Fifty-four adults [27 males, 27 females; mean age \pm standard deviation (SD) 26.3 ± 4.8 years] who completed orthodontic treatment more than 6 months prior to recruitment participated in the study. Orthodontic study casts were graded according to the American Board of Orthodontics (ABO) cast-radiograph (CR) evaluation system, and categorized as ABO group ($N = 29$; meeting the board standards with CR score ≤ 27) or non-ABO group ($N = 25$; failing to meet the board standards, CR >27). Each subject performed chewing sequences of 20 chewing cycles on experimental silicon food at the rate of 80 cycles/minute. Silicon fragments were separated using a series of six sieves of decreasing mesh size to measure the median particle size (MPS) and the broadness of particle distribution (BPD). Surface electromyography was used to compute standardized electromyographic indices measuring the influence of occlusion on the activation of the temporalis and masseter muscles during experimental maximum clenching and gum chewing. Self-assessment of chewing function was determined using 0-100 mm visual analogue scales (VAS). Mann-Whitney U - and t -tests were used to detect differences in outcome measures between the study groups.

RESULTS: The ABO group demonstrated more balanced and symmetric activation of the left and right temporalis muscles during maximum clenching compared to the non-ABO group ($P = 0.016$), and chewed a gum at a slower rate (mean rate 90 cycles/minute; SD = 12) than the non-ABO group (mean rate 102 cycles/minute; SD = 12; $P = 0.030$). The ABO group reported having more difficulty chewing nuts [median VAS score 3; interquartile range (IQR) = 16] than the non-ABO group (median VAS score 0; IQR = 5; $P = 0.032$). No significant between-group differences were found in MPS and BPD scores.

CONCLUSION: Good dental occlusion that meets the ABO standards is associated with more balanced jaw muscle activity, and a slower chewing rate, which may contribute to preventing jaw muscle fatigue.

OP 37 STABILITY OF LOWER INCISOR POSITION FOLLOWING TWO PHASE NON-EXTRACTION TREATMENT

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AIMS: Long-term stability of lower incisors is variable and unpredictable and cephalometric positional changes during treatment may contribute to the potential for instability. This study evaluated the stability and changes induced to lower incisor position following a two phase non-extraction approach in growing patients.

MATERIALS AND METHOD: The cephalometric records of 40 patients' (20 males; 20 females) were selected who had been successfully treated utilizing a headgear activator (HGA) including lower incisor capping (Phase I), followed by full-fixed appliances (Phase II). Three evaluation periods were analyzed for five lower incisor (LI) positional changes: before treatment (T0), end of phase I (T1) and end of phase II (T2). The control group consisted of age-matched, untreated subjects from the Burlington Growth Study and were compared to the patient data as well as a predicted growth forecast. Net treatment effects were calculated by subtracting the treatment data from the control data and eliminating any changes due to growth. Data were analyzed employing descriptive statistics, Chi-square and *t*-tests.

RESULTS: LI/NB was proclined 2.4° at T1 ($P > 0.05$); 5.3° at T2 and 9° from T0 to T2 ($P < 0.01$), LI/APog proclined 4° at T1 ($P < 0.01$); 5.3° at T2 and 10.3° from T0 to T2 ($P < 0.01$), LI/MPA proclined 1.7° at T1 ($P > 0.05$); 4.1° at T2 and 7.4° from T0 to T2 ($P < 0.01$), LI proclination was highly statistically significant ($P < 0.01$) at T2 compared T0 with most proclination occurring during the second phase of treatment. LI protrusion also increased to a highly significant ($P < 0.01$) magnitude for LI-NB (1.9 mm) and LI-APog (3.2 mm) parameters. Growth forecast values were highly significantly under-forecast ($P < 0.01$)

CONCLUSION: Both functional and full-fixed appliances proclined and protruded the lower incisors, potentially into less stable positions, compared to the control subjects. Full-fixed appliances accounted for approximately 75-80 per cent of LI proclination and 32-60 per cent of the protrusion observed in two-phase treatment. Growth forecasting was inaccurate. Capping the lower incisors during phase I treatment controls lower incisor tipping, but control is not effective during full-fixed therapy. Long-term retention is advised after two-phase non-extraction orthodontic therapy to maintain the new LI position.

OP 38 UNEXPECTED TOOTH MOVEMENT DESPITE BONDED RETAINERS: PREVALENCE AND MOVEMENT PATTERNS

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AIMS: During recent years, unexpected complications (torque movements) under fixed retention have been increasingly reported. Therefore, the aim was to visualize and analyze the prevalence and variety of movement patterns of such complications.

SUBJECTS AND METHOD: All patients who completed orthodontic treatment at during three consecutive years were assessed. Inclusion criteria were: (1) multibracket appliance treatment in both jaws, (2) bonded canine-to-canine retainers in the upper and lower arches and (3) intact plaster casts from debonding (T1) and after two years of supervised retention (T2). All patients were screened by an orthodontic resident. Those with suspected tooth movements during retention were

judged by two experienced orthodontists to reach consensus. The plaster casts (T1, T2) of all patients with tooth movements were scanned with a desktop scanner. Upper arch scans were superimposed using the stable structures of the hard palate, while for the lower arch scans the best fit (premolars and first molars) was used. Tooth movements of canines, lateral and central incisors were measured in all three planes of space. Additional data from the patients' records regarding the pre-treatment situation, habits and complications (debondings, breakages) during the retention period were recorded.

RESULTS: Forty four (26.9%) out of 163 patients with upper and lower bonded retainers showed visually detectable unexpected tooth movements in one or both arches. These tooth movements were more often located in the upper (20.7%) than in the lower arch (14.0%). Tooth movements occurred in all directions and no homogenous movement patterns could be detected.

CONCLUSION: Compared to the current literature, which solely deals with mandibular retainers, the prevalence found in the present study was relatively low (mandible: 14.0% versus 1.1-43.3%). Nevertheless, the prevalence of unexpected tooth movement in the maxilla was even higher (20.7%) and has to be considered in clinical practice. The detected tooth movements were inhomogenous and showed a large variety.

OP 39 COMPARISON OF MANDIBULAR GROWTH VELOCITY AT DIFFERENT CERVICAL VERTEBRAL MATURATION STAGES

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AIMS: Knowledge of a patient's stage of growth and development plays a vital role in diagnosis, treatment planning, results and stability of a patient's outcome. Cervical vertebral maturation (CVM) predicts the stage of growth and development, but its validity has only been investigated retrospectively, using historic samples. The aim of this research was to prospectively assess whether a correlation exists between CVM stage and mandibular growth velocity in a current population sample.

MATERIALS AND METHOD: This was a prospective longitudinal (Ethical approval: Liverpool East Research Ethics Committee; reference number 13/NW/0408; protocol number UoL000751). CVM stage was assessed from lateral cephalograms of participants aged between 8-18 years and of any gender taken when clinically appropriate, at pre-treatment, post-functional and pre-finish stages of treatment. They were never taken solely for the purpose of the research. Mandibular growth was measured using the mean change in the area of the triangle Condylion-Gonion-Gnathion. Intra- and interobserver reliability of CVM staging was assessed using Cohen's weighted kappa, and percentage agreement. Intraobserver reliability of cephalometric linear measurements was assessed using intraclass correlation coefficient and Bland and Altman plots. Analysis of variance was used to test for statistically significant differences between mandibular growth velocity at the different CVM stages.

RESULTS: One hundred and eight participants were included for analysis. No statistically significant difference, in the mean annualised mandibular growth velocity between any CVM stages, was found.

CONCLUSION: The findings suggest that there is no statistically significant relationship between CVM stage and mandibular growth velocity.

OP 40 SECULAR TREND IN CHILDREN BORN 1969-1973 AND 1996-2000. A STUDY OF SKELETAL MATURATION OF THE HAND AND WRIST IN RELATION TO THE PUBERTAL GROWTH SPURT

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AIMS: To determine whether a secular trend is evident among children born between 1969-1973 and 1996-2000 by analyzing pubertal events, assessed by 1) the chronological age at peak height velocity (PHV), 2) the velocity at PHV, and 3) the duration of skeletal maturation in relation to PHV.

MATERIALS AND METHOD: The chronological age and velocity at PHV were measured manually on individually constructed growth velocity curves of 100 children (37 girls, 63 boys) born between 1969-1973 and 71 children (22 girls, 49 boys) born between 1996-2000. Radiographs of the hand and wrist, taken during orthodontic treatment of the children, were categorized into seven skeletal

maturity stages (PP2=, MP3=, S, MP3cap, DP3u, PP3u, and MP3u). Children with growth abnormalities were excluded. The groups were matched for gender and skeletal maturation. The differences between the groups were adjusted for age and gender and were analyzed using a linear model.

RESULTS: The chronological age was 0.5 years younger ($P = 0.001$) and the velocity was 0.7 cm/year higher ($P = 0.003$) at PHV in the 1996-2000 group compared to the 1969-1973 group. These results are applicable for both genders. No significant difference in the sequence of the duration of the skeletal maturation between the groups was found ($P = 0.465$). In both groups, the skeletal maturity stages occurred significantly in the following sequence: PP2= 2.2 years, MP3= 1.6 years, S 1.1 years, and MP3cap 0.4 years prior to PHV ($P < 0.05$).

CONCLUSION: These are the first results to illustrate that the duration of skeletal maturation, in relation to PHV, is not affected by a secular trend. However, due to a declining chronological age at PHV, the skeletal maturation in relation to chronological age is earlier for both genders in the 1996-2000 group compared to the 1969-1973 group. These findings may be valuable in relation to the timing of orthodontic treatment in growing patients, as well as in the planning of the retention period.

OP 41 EVALUATION OF THE SUTURE MATURATION OF UNTREATED PATIENTS USING COMPUTERIZED TOMOGRAPHY

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AIMS: To retrospectively evaluate the midpalatal suture (MPS) and speno-occipital synchondrosis obliteration (SOS) stage and the zygomaticomaxillary suture (ZMS) maturation stage in patients of different age groups who had not received any orthodontic treatment and to check whether there is a correlation between these parameters. A further aim was to verify the correlation between MPS maturation stage, palatal bone thickness and length.

MATERIALS AND METHOD: Paranasal sinus computed tomography (CT) images of 314 patients between the ages of 7 and 30 years were divided into six groups according to their age ranges. Images of individuals aged 7-10 years, 11-13 years, 14-16 years, 17-20 years, 21-25 years 26-30 years. MPS, ZMS and SOS maturation degrees were determined, and palatal bone thickness and palatal bone length were measured. The data were analyzed using the Statistical Package for Social Sciences for Windows 22.0.

RESULTS: A positive correlation was found between MPS, ZMS maturation and SOS closure degree (MPS-ZMS $r = 0.816$, MPS-SOS $r = 0.736$, ZMS-SOS, $r = 0.868$, $P = 0.000 < 0.05$). As the degree of MPS maturation increased, the degree of ZMS maturation and the degree of SOS closure were significantly increased. Another finding was the delay of maxillofacial suture maturation in patients with a long and thick palatal bone (MPS-palatal bone thickness $r = 0.405$, MPS-palatal bone length $r = 0.387$, $P = 0.000 < 0.05$).

CONCLUSION: MPS maturation was found to be related to ZMS and SOS closure degree, and palatal bone morphology.

OP 42 COMPARISON OF MAXILLARY SUTURE ASSESSMENT ON CONE BEAM COMPUTED TOMOGRAPHS AND MAGNETIC RESONANCE IMAGING: A RETROSPECTIVE STUDY IN ADULTS

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AIMS: Assessing maxillary suture anatomy and stages of development is fundamental for treatment planning in the case of deformities affecting the maxillary complex. The aim of this study was to compare the use of magnetic resonance images (MRI) and cone beam computed tomographs (CBCT) in the analysis of maxillary sutures.

MATERIALS AND METHOD: MRIs and CBCTs of the maxillary complex of 53 subjects (25 males, 28 females) between 22 and 87 years of age (mean = 54.8 years) were collected retrospectively. Maxillary sutures were identified on MRIs and corresponding CBCT slices were created with the same orientation. The lengths of the premaxillary, maxillary, and palatal bones were compared between CBCT and MRI with a paired-samples *t*-test ($\alpha = 0.05$). Pearson correlations were rated as

'low' if between ± 0.00 and ± 0.29 , 'moderate' if between ± 0.30 and ± 0.49 , and 'high' if between ± 0.50 and ± 1.00 .

RESULTS: The mean midpalatal suture length was 51.8 mm on CBCT and 53.3 mm on MRI. The mean premaxillary length was 13.4 mm on CBCT and 12.9 mm on MRI. The mean maxillary length was 25.1 mm on CBCT and 26.9 mm on MRI. The mean palatal length was 13.3 mm on CBCT and 13.5 mm on MRI. Palatal length (mean $\Delta = 0.2$ mm, $P = 0.438$) was not statistically different between the two groups. However, significant differences between CBCT and MRI were present in the maxillary complex length (mean $\Delta = 1.0$ mm, $P < 0.001$), in the premaxillary length (mean $\Delta = 0.7$ mm, $P = 0.014$), and in the maxillary length (mean $\Delta = 1.5$ mm, $P < 0.001$). A high positive correlation between the two examinations was found for maxillary complex length ($r = 0.59$), and premaxillary length ($r = 0.61$), whereas maxillary length and palatal length showed moderate correlations ($r = 0.46$, $r = 0.35$, respectively).

CONCLUSION: These findings show that some limitations exist in the analysis of maxillary sutures on MRI. However, given the advantages of the absence of radiation exposure, MRI can still be used when errors in the range of 1 mm do not compromise diagnostic accuracy.

OP 43 EXPLORING A NEW ANATOMIC STRUCTURE FOR SUPERIMPOSITION OF PRE- AND POST-TREATMENT MANDIBULAR DIGITAL DENTAL CASTS

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AIMS: To propose an anatomical mandibular structure for three-dimensional (3D) use and superimposition to evaluate orthodontic movement and then to compare with the two-dimensional (2D) lateral cephalometric gold standard.

MATERIALS AND METHOD: Thirty consecutive patients with complete orthodontic files were included in the study. The pre- and post-treatment casts were present together with the pre- and post-treatment cephalometric radiographs. The casts were scanned. Mandibular superimposition was performed using Avizo software. In the mandible, the mylohyoid lines were chosen as a reference structure and were superimposed.

RESULTS: There were statistically significant differences in the results. A Wilcoxon test was performed and completed with a Student's t -test with $P > 0.05$. No statistical difference was observed between 2D and 3D superimposition.

CONCLUSION: The mylohyoid line is a suitable reference for mandibular superimposition. The technique is reliable and suitable for research work and clinical evaluation.

OP 44 THE EFFECT OF THREE DIFFERENT RAPID MAXILLARY EXPANDERS ON THE UPPER AIRWAY. A CONE BEAM COMPUTED TOMOGRAPHY, RANDOMISED CONTROLLED CLINICAL TRIAL

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AIMS: To assess and compare changes in upper airway volume after treatment with three different rapid maxillary expanders using cone beam computed tomography (CBCT).

SUBJECTS AND METHOD: Sixty patients (38 females, 22 males) with a median age of 14.2 years (range 13-15 years) were randomized to a 1:1:1 ratio. The appliances used were a traditional Hyrax, a tooth-bone-borne Hybrid-Hyrax and a novel Keles keyless expander. Blinding occurred only during outcome assessment. Patients were expanded at a rate of 0.5 mm a day and monitored weekly until adequate overexpansion was achieved with the upper molar palatal cusps contacting the lower molar buccal cusps. CBCTs were obtained prior to appliance insertion (T0) and after 6 months, at appliance removal (T1). The primary outcome was overall airway volume changes, with secondary outcomes to identify if the volume of change differed in the nasal cavity, nasopharynx and oropharynx using Dolphin 3D software. Reliability and method error were assessed with intraclass correlation coefficient (ICC) and a t -test of repeated measurements, respectively. Analysis of variance was used to compare changes between the three groups.

RESULTS: Baseline characteristics were similar and nine patients were lost during the trial. ICC between repeated measurements was excellent ($r > 0.975$) and no significant differences were seen between repeated measurements ($P > 0.05$). For total airway volume, statistically significant changes were only found in the Hybrid-Hyrax group (5902 mm³). Compartmental changes in the airway were found in the sinus (2285 mm³) and oropharynx (1543 mm³) compartments of the Keles group and

the sinus (1208 mm³), nasal cavity (1304 mm³), nasopharynx (219 mm³) of the Hybrid-Hyrax group ($P < 0.05$). No statistically significant differences were found in any compartment and the total airway for Hyrax. No significant differences were found between the three expanders for all the assessed parameters.

CONCLUSION: In this prospective randomized controlled clinical trial, comparisons of the upper airway volume on CBCT showed a significant airway increase in the Hybrid-Hyrax group. No significant changes were noted in the Hyrax group and the significant changes in the Keles group were restricted to the sinus and oropharynx. The Hybrid-Hyrax may be recommended in older individuals when significant changes in the upper airway are required.

OP 45 EFFECTS ON MIDPALATAL SUTURE AND NASAL AIRFLOW USING TOOTH-BORNE AND TOOTH-BONE-BORNE RME APPLIANCES: A RANDOMIZED CONTROLLED TRIAL

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AIMS: To evaluate and compare the effects of tooth-borne (TB) and tooth-bone-borne (TBB) rapid maxillary expansion (RME) on the midpalatal suture and nasal airflow and resistance.

SUBJECTS AND METHOD: Fifty-four consecutive patients who met the eligibility criteria were recruited from September 2010 to December 2015. Of these 54 subjects, 52 agreed to participate in the study. The 52 subjects were allocated to either the TB group, mean age 9.3 years (SD 1.3), or the TBB group, mean age 9.5 years (SD 1.2). All subjects had constricted maxillae with uni- or bilateral crossbites. The examination protocol included plaster models, radiographic examination with cone beam computed tomography (CBCT) and 40 of the 52 subjects also underwent rhinomanometric registration at baseline (T0) and post-expansion registration (T1). The study outcomes, midpalatal sutural opening, nasal airflow and nasal airway resistance, were evaluated with random intercept linear mixed model and linear regression.

RESULTS: The TBB group showed significantly larger midpalatal sutural expansion than the TB group after expansion ($P = 0.003$). Complete case analysis showed significantly higher T2 nasal airflow values for the TBB group compared to the TB group, mean difference 51.0 cm³/s ($P = 0.018$). Even the reduction in nasal airway resistance showed a similar pattern in favour of the TBB group.

CONCLUSION: The TBB-RME induced significantly larger expansion in the midpalatal suture and higher nasal airway flow and lower nasal resistance values than TB-RME. It might be wiser to use TBB-RME in patients with constricted maxilla and upper airway obstruction.

OP 46 CLASS II MALOCCLUSION TREATMENT: BONE ANCHORED VERSUS. NORMAL INTERMAXILLARY ELASTIC USE

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AIMS: The incidence of Class II malocclusions is very high in society. Intermaxillary elastics are one of the most commonly used methods in Class II treatment. The aim of this study was to evaluate skeletal and dental effects during the treatment of Class II, in adolescents using Class II elastics by two different methods.

SUBJECTS AND METHOD: Thirty patients; 12-15 years of age with Class II malocclusions referred for treatment were evaluated. All patients had mandibular deficiency with normal maxillary development. The patients were randomly divided into two groups. Group 1 (G1), 15 subjects comprised the bone anchored Class II elastic group and G2, also 15 subjects, were the normal Class II elastic group. Miniscrews (1.8 mm diameter, 8 mm long) were placed between the upper canine and first premolar and lower first and second molar in G1 patients. The stainless steel hook was clamped to miniscrews for use of Class II elastics. Patients in G2 used Class II elastics from upper canine to lower first molar. The course of treatment was documented cephalometrically. Initial and final data were evaluated. An independent *t*-test was used to evaluate differences between the two groups.

RESULTS: There was no statistically significant differences in SNB, ANB, Wits, overjet, (UP6-PTV)-(LO6-PTV), (UP1-PTV)-(N-ANS on FH) and (UP6-PTV)-(N-ANS on FH). There was a statistically significant difference in (LO1-PTV)-(N-Pog on FH) and IMPA values between G1 and G2 ($P < 0.01$).

CONCLUSION: According to the results, the bone anchored Class II elastic group had less proclination of the lower incisors.

OP 47 *IN VIVO* FAILURE OF TEMPORARY ANCHORAGE DEVICES COATED WITH HYDROXYAPATITE-CHOLECALCIFEROL VERSUS HYDROXYAPATITE ONLY: A SPLIT MOUTH RANDOMIZED CONTROL TRIAL
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AIMS: To compare, in a triple blinded split mouth randomized clinical control trial (RCT), the *in vivo* failure of temporary anchorage devices (TADs) coated with hydroxyapatite incorporated with cholecalciferol with that of hydroxyapatite only over a 12 month period.

SUBJECTS AND METHOD: Twenty two patients with a skeletal Class II division 1 malocclusion requiring anchorage from TADs for retraction of upper incisors into extracted premolar space were recruited in this triple blinded, parallel group, split-mouth, RCT. A block randomization sequence (1:1) was generated with the help of random allocation software with allocation concealed in sequentially numbered, opaque, sealed envelopes. A total of 44 TADs with a diameter of 1.6 mm and a length of 10 mm were placed in the maxillary arches. Hydroxyapatite incorporated with cholecalciferol was coated onto Ti6Al4V TADs using a biomimetic precipitation method for sustained release of cholecalciferol on one side of the maxilla and TADs coated with hydroxyapatite only on the other side. All TADs were placed between the roots of the second premolar and first molar and were immediately loaded. Patients were followed for 12 months for failure/loosening of the TADs. The data was analyzed blind on an intention to treat basis.

RESULTS: Two TADs failed in the hydroxyapatite only group (9.1%) while four TADs (18.2%) failed in the hydroxyapatite-cholecalciferol group. Kaplan-Meier graphs were plotted. The McNemar test revealed a highly significant difference ($P = 0.00$) between the two groups. The odds ratio was 2.22 (95% confidence interval 0.363-13.62).

CONCLUSION: The implants coated with hydroxyapatite-cholecalciferol are twice as likely to fail compared with hydroxyapatite only when placed in the maxilla. The failure rate of hydroxyapatite only TADs corresponds to uncoated TADs investigated in a previous published study using the same criteria. Although cholecalciferol increases the failure rate when incorporated with hydroxyapatite, the same method of using biomimetic precipitation of hydroxyapatite incorporated with other drugs on surfaces of TADs can be used for sustained release of these medicaments to improve TAD stability in future.

OP 48 DO ORTHODONTIC POSTGRADUATE STUDENTS KNOW EVIDENCE-BASED RESEARCH METHODOLOGY AND HOW DO THEY COMPARE WITH OTHER SPECIALTIES? AN INTERNATIONAL SURVEY

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AIMS: To assess the knowledge of postgraduate students of dentistry about evidence-based methodology pertaining to the design, conduct, and critical appraisal of clinical trials.

SUBJECTS AND METHOD: Senior postgraduate students of any dental specialty were surveyed from the dental schools of three universities in Athens (Greece), Boston (United States of America), and Zurich (Switzerland). A total of 96 postgraduate students were finally included with a mean age of 30.0 ± 3.1 years, of whom 45 (47%) were male. The proportion of students answering correctly each of the 10 questions of the survey, as well as the cumulative scores were analyzed statistically with descriptive statistics and logistic/linear regression analysis at alpha = 5 per cent.

RESULTS: The overall percentage score of correct answers was 45.6 ± 15.0 , with the percentage of correct answers to each question ranging from 13.5 to 86.5. The questions answered worst pertained to correctly characterizing sensitivity/specificity (13.5%), the number needed to treat (14.0%), the credibility of trial synthesis in meta-analysis (23.7%), and publication bias (29.5%). About half of the responders could correctly characterize the diagnostic positive predictive value (43.6%), the benefits of sample size calculation (54.7%), and common diagrams found in randomized

trials and systematic reviews papers (56.8%). Finally, the vast majority of postgraduate students could correctly identify the role of the statistical power of a trial (63.8%), random allocation sequence in a randomized trial (76.0%), and blinding in a randomized trial (86.5%). No considerable differences were found in the overall score among the three surveyed universities ($P = 0.50$), although postgraduate students from paediatric dentistry departments scored significantly better than students from other departments (16.4% better; 95% confidence interval: 4.9 to 27.9%; $P = 0.006$).

CONCLUSION: Postgraduate students in orthodontics and other dental specialties possessed moderate knowledge on evidence-based methodology and clinical trials. Efforts should be made to integrate such subjects in the postgraduate curricula of universities, so that dental specialists can critically appraise such research papers.

OP 49 PUBLIC PERCEPTION OF ORTHODONTIC TREATMENT PERFORMED BY GENERAL DENTISTS AND SPECIALIST ORTHODONTISTS

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AIMS: To determine the public's understanding of the difference between a specialist orthodontist and a general dental practitioner (GDP) who provide orthodontic treatment.

SUBJECTS AND METHOD: Two thousand and six Australian adults registered with a survey organisation completed an online questionnaire. Participants were chosen to reflect age and state demographic data provided by the 2016 Australian Census. The survey questions examined the respondents' understanding regarding the difference between a GDP and a specialist orthodontist relating to training and qualifications. Furthermore, factors influencing respondents' preferences for choosing an orthodontic practitioner as well as demographic data were collected.

RESULTS: Sixty six per cent of respondents felt that a dentist who provided orthodontic treatment must also be a specialist orthodontist whilst 27 per cent were unsure. Seventy four per cent of respondents felt that a specialist orthodontist was the most qualified person to provide orthodontic treatment. The most popular factor in deciding which type of practitioner to see for orthodontic treatment was whether they were a specialist, followed closely by cost. A GDP was more likely to be chosen as an orthodontic practitioner by respondents who were male, less educated, had a lower income or had seen a GDP for orthodontic treatment in the past.

CONCLUSION: Although the respondents generally appeared to appreciate the value of seeing a specialist for orthodontic treatment, a significant proportion did not appear to understand the difference between a specialist orthodontist and a GDP. The present findings support further education of the public.

OP 50 LARGE OVERJETS DO INCREASE THE RISK OF TRAUMATIC TOOTH INJURIES

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AIMS: Dental trauma is a very common issue in dentistry and its occurrence has been related to many factors. The aim of this prospective study was to evaluate if a specific sample population of schoolchildren with large overjets experience a greater risk of tooth damage compared to children with a normal overjet.

SUBJECTS AND METHOD: A sample of 1900 children aged 6-13 years was prospectively evaluated to determine the number and types of injuries, the influence of overjet on the risk of suffering trauma and the relationships between trauma, age, gender and social conditions.

RESULTS: The observed prevalence of trauma was higher for boys, with a slight risk increase with age and a peak frequency at the age of 10 years. Most of the injuries (91.2%) involved the upper anterior teeth; of all injuries 87.2 per cent were hard tissue injuries (enamel or dentine fractures), and 12.8 per cent only subluxation and luxation injuries. Children with an overjet of 6 mm or more had a higher risk of suffering trauma, compared with those with a smaller overjet, the relative risk being $RR = 3.37$ with confidence interval (1.81;6.27).

CONCLUSION: This prospective study confirmed most of the results from earlier research dealing with epidemiological factors of dental injuries to the permanent dentition. Of all the variables

analysed, overjet stood out as the most significant risk factor: an increased overjet of 6 mm or more had a major impact on the risk of trauma, which would speak in favour of early orthodontic correction of an increased overjet to reduce the prevalence of dental trauma.

OP 51 ORTHODONTIC, EAR, NOSE AND THROAT AND THREE-DIMENSIONAL ULTRASOUND ASSESSMENT OF RESTING TONGUE POSTURE IN ANTERIOR OPEN BITE PRIMARY DENTITIONS

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AIMS: To assess the resting tongue posture in preschool children with and without an anterior open bite (AOB) using three-dimensional ultrasonography (3D US) and to compare the method to orthodontic and ear-nose-throat (ENT) assessment. Irregular tongue posture is stressed in the aetiology of AOB and unpredictable post-treatment stability. The assessment of tongue posture in growing children is unreliable due to anatomical limitations.

SUBJECTS AND METHOD: Four hundred and forty six children aged 3-7 years, visiting local kindergartens in Slovenia. The subjects were examined for AOB malocclusion, orofacial and ENT impairment, oral habits and speech. Questionnaires were answered by their parents. Participants presenting an AOB in the primary dentition were allocated to the research group, the rest were included in the control group. Further orthodontic clinical examinations, facial and oral photographs and dental casts were obtained in AOB subjects only. An ENT specialist examined ENT condition. The 3D US of resting tongue posture was assessed by a radiologist and an orthodontist independently. The device used was 3D US Voluson 730 (General Electrics Healthcare). 3D US data were analysed by the 4D View Program 5.0. The R-Program was used for collated data statistical analysis, descriptive statistics, Mann-Whitney, chi-square or Fisher's exact, McNemar test and multiple logistic regression models. Statistical significance was set at $P < 0.05$.

RESULTS: The 32 preschool children aged 3.5-7 years (mean 5.0 ± 0.9 years) presented an AOB in the primary dentition; the prevalence of an AOB was 7.2 per cent. Subjects with an AOB presented a higher occurrence of orofacial and ENT irregularities, speech disorders and low tongue posture. 3D US detected the highest number of AOB subjects with a low tongue posture on the mouth of the floor, with no significant difference among 3D US and both clinical assessments.

CONCLUSION: There is a strong relationship among AOB and low tongue posture. A 3D US assessment is an objective, non-invasive, radiation free, less time-consuming and child-friendly method for functional assessment of tongue posture in preschool children and should become a useful tool in clinical diagnostics, prevention of dentofacial deformities development, and for treatment planning in children with an AOB. The child and his/her parents should receive early information about the correct resting tongue posture to be aware of optimal conditions in the oral cavity for proper orofacial and articulation development.