

## **2017 AAO Annual Session Charley Schultz Resident Scholar Award**

The Charley Schultz Resident Scholar Award program will be held on Saturday, April 22 in the San Diego Convention Center – Room 7 from 1:00pm-2:00pm. Clinicians will be at their posterboards during this time to answer questions about their research.

\*- Denotes financial interest or visual enhancement

### **Basic Science Research**

#### **Pig dental pulp stem cell behavior on silk scaffolds in vitro**

Mohammed Barashi  
Tufts University

Objective: To determine whether incorporation of extracellular matrix (ECM) derived from decellularized pig tooth buds (tECM) into silk scaffolds would enhance dental pulp derived dental mesenchymal stem cell (DMSC) differentiation. Methods: Nine different types of silk scaffolds were fabricated: 1) 6% silk; 2) 6% silk+tECM; 3) 6% silk+collagen; 4) 3% silk 4g salt; 5) 3% silk 4g salt + tECM; 6) 3% silk 4g salt +collagen; 7) 3% silk 2g salt; 8) 3% silk 2g salt +tECM; and 9) 3% silk 2g salt +collagen. Porcine DMSCs (pDMSCs) at seeded into silk scaffolds and cultured in vitro in osteogenic media for 24 hours, 2 and 4 weeks. Unseeded silk scaffolds were used as controls. Results: Preliminary bright field light microscopic analyses revealed pDMSC attachment and proliferation of stem cells after two and four weeks in vitro culture. Conclusion: Silk scaffolds are suitable to support the attachment and proliferation of seeded pDMSCs.

#### **AcceleDent® altered transcript expression in PDL cells**

Katelyn Blanchard  
Louisiana State University

Background: Secreted proteins from PDL cells regulate the processes of bone resorption and deposition. AcceleDent® is marketed to hasten tooth movement by oscillating the teeth. Purpose: Investigate the cellular mechanism of AcceleDent®. Methods: A) PDL cells were stretched over a flexible membrane and vibrated with the AcceleDent® 20 minutes/day for three days. RNA was isolated after 24 hours and RT-PCR analysis was done. B) Cells were treated once for 20 minutes and harvested for PCR analysis after 3, 6 or 12 hours. Densitometric analysis compared levels of transcript expression. Results: After three daily exposures there were no changes in transcripts regulating osteoclasts, osteogenesis, or tested growth factors. One time treatment induced an increase in the expression of RANKL after 3 hours decreasing by 6 hours. Conclusions: The transient changes in RANKL transcript expression supports that AcceleDent® treatment can transiently activate osteoclasts enhancing alveolar remodeling.

#### **Maturation of dental pulp stem cell-derived blood vessels**

Xi Chen  
University of Michigan

Introduction: Root canal treatment (RCT) is the most widely used therapy for pulpitis. However, dental pulp engineering has emerged as a potential alternative treatment to traditional RCT. In this study, we investigated the effect of pericyte investment on blood vessel maturation in engineered dental pulps. Methods: Tooth slide/scaffold were prepared by seeding with DPSC and transplanted into immunodeficient mouse. Immunofluorescence staining and immunohistochemistry were used to visualize the relationship between pericyte and endothelial cells. Scratch assay and transwell assay were used to exam whether PDGF secreted from DPSC-derived endothelial cells increase smooth muscle cell migration. Results: pericyte investment increases with the increase of the maturation stage of blood vessel. Smooth muscle cells cultured with conditioned medium showed enhanced migratory phenotype. PDGF signaling pathway contributes, at least in part, to the interaction between endothelial cells and SMCs.

### **Proteomic characterization of exosomes released by osteoclasts and odontoclasts**

Alyssa Emory-Carter  
University of Florida

Background: Osteoclasts and odontoclasts secrete vesicles called exosomes, which are an appealing source of biomarkers. Purpose: To identify exosomal proteins that can distinguish between bone and dentin resorption. Methods: Mouse 'clasts were cultured on either plastic, dentin or bone. Exosomes were isolated from the media and analyzed for proteomic differences using two-dimensional mass spectrometry. For each protein, the difference between the total ion count (TIC) values were mapped to an expression ratio histogram (Z-score) in order to detect proteins differentially expressed. Results: 2,183 proteins were identified. Plexin-B1 (Z=12.4) and Serpin A11 (Z=12.3) were uniquely present in odontoclast exosomes. Stabilin-1 and the oxidative phosphorylation pathway proteins were enriched in exosomes from osteoclasts and odontoclasts, but not in exosomes from non-resorbing cells on plastic. Conclusion: Exosomal proteins are potential biomarkers of root resorption or bone remodeling.

### **Skeletal anchorage in a rat model of orthodontic tooth movement (OTM)**

Sudha Gudhimella  
University of Kentucky

Objectives: The purpose of this study was to determine the viability of a skeletal anchorage, and the effect of low force (~3cN) on bone adaptation in response to tooth movement. Methods: 90 Sprague-dawley rats were divided in to 5 groups (3, 7, 14, 28 and 40 days). A micro implant was used to protract the first molar with a NiTi coil spring exerting a 3cN load (experimental)/ 0cN (Sham) in a split mouth design. The stability of the micro implants, linear and angular displacement of first molar via  $\mu$ CT and BV/TV values of interradicular bone were evaluated Results: The success rate of mini implants and NiTi springs was 100%. The BV/TV values in interradicular bone, linear and angular displacement of first molar measurement are undergoing. Conclusions: The findings from the study suggest a novel modification to a commonly model for OTM using a secure anchorage and appropriate force. Funding- AAOF RAA

### **Orofacial clefting and caries: do they share a genetic etiology?**

Mohamed Hassan  
Alexandria University

Background: P63 gene is vital to palatogenesis and amelogenesis. CLP caused by p63 mutation is accompanied by extensive dental defects not fully characterized. Aim: To investigate the effect of losing one p63 allele on enamel structure and salivary gland formation using morphological and histological data. Methods: Enamel structure, density and volume of prenatal (E18) heterozygous p63<sup>+/-</sup> and wild-type p63<sup>+/+</sup> mice were assessed using micro-computed tomography and scanning electron microscopy. Salivary glands of heterozygous and wild-type adult mice were examined histologically. Results: This study may help explain the etiology and the risk of white spot and carious lesions associated with orthodontic patients with malocclusion. White spot lesions may be linked to treatment instrumentations and patient cooperation, as well as genetics.

### **Differential signaling of PTH(1-34) from PTHrP(1-36) and abaloparatide in osteoblastic cells**

Ginny Ching-Yun Hsu  
New York University

Background: Parathyroid hormone (PTH) plays a key role in calcium metabolism. However, the "anabolic window" of PTH treatment limits its usefulness in treating osteoporosis. Thus, other therapies are under investigation, including Parathyroid hormone-related protein (PTHrP) and its analog, abaloparatide (ABL). Purpose: With increasing patient population of adult women in orthodontics, it is important to seek treatment for those suffering from osteoporosis. Research Design: Osteoblastic UMR 106-01 cells were treated with PTH, PTHrP or ABL for various times and concentrations, cell lysates were subjected to Western blots for activation of ERK1/2 and CREB. Results: PTH results in relatively greater increase of CREB phosphorylation (activation). All three peptides have peak ERK1/2 activation at 5 minutes which

decreases with increasing time and concentration. Conclusion: It highlights the differences between the peptides and may provide an explanation for the superior effects of ABL.

### **Effect of IG9402 (osteocyte apoptosis inhibitor) on tooth movement and alveolar bone**

Imad Maleeh  
Columbia University

A bisphosphonate analog (IG9402) has been developed that blocks osteocyte apoptosis. Therapeutic use of this new drug in orthodontic treatment may be promising. This study assesses the influence of IG9402 on tooth movement and alveolar bone volume fraction in a mouse model. 10 CD1 mice were divided into a control group (6: saline) and experimental group (4: IG9402). Molars were moved using NiTi springs. IG9402 or saline were given for 10 days. Mouse palates were scanned. Linear measurements of tooth movement and alveolar bone volume fraction of the maxillary first molar furcation were recorded. There was a statistically significant increase in alveolar bone volume fraction in the experimental group compared to the control group. No statistically significant difference was seen in tooth movement. Our study displays the potential use of IG9402 during orthodontic treatment in individuals with compromised alveolar bone density, such as those with periodontal disease and osteoporosis.

### **Structural derived function: the pre-programming of the periodontal ligament**

Gili Naveh  
Boston University

In orthodontics external forces are used to initiate a cascade of structural modifications inside the PDL. These in turn lead to alveolar bone remodeling and tooth movement. Despite of the central role of the PDL in orthodontic tooth movement its structure and function remain unclear. Here we show that the PDL has preprogrammed structural internal driving forces that guide the tooth function. We were able to elucidate the 3D fibrous structure of a fresh mouse molar PDL and follow the organizational changes throughout different developmental and functional stages. Primarily, we demonstrated that the fibrous network is not uniform in its distribution and is organized in dense and sparse networks. Fascinatingly, the distribution of the networks is determined even before the tooth is erupted. We can thus state that the PDL non uniform collagenous component function is derived by its structure and therefore guided internal structural changes might lead to functional ones.

### **The influence of cortical bone thickness on miniscrew microcrack formation**

Melissa Nguyen  
University of Adelaide

Background: Orthodontic miniscrew (OM) insertion elicits microdamage which initiates remodeling, potentially causing OM instability. Purpose: To investigate the influence of cortical bone thickness on the amount of microdamage produced following OM insertion in porcine bone. Design: 1.5x6mm Aarhus OMs were inserted into 1.0mm (Group A; n=10), 1.5mm (Group B; n=10) and 2.0mm (Group C; n=10) bone using 18Ncm. A sequential staining protocol was used to identify microdamage under laser confocal microscopy. Total damage area, diffuse damage area, maximum crack length, maximum damage radius, and maximum diffuse damage radius were quantified. Results: 2 OMs from Group B and all OMs in Group C failed to insert. Group C displayed larger amounts of microdamage compared with Group A and B. Conclusion: More microdamage was observed following insertion into 2.0mm thick bone compared with 1.0mm bone. Mechanisms to reduce cortical bone thickness would likely reduce the amount of microdamage formed.

### **Short term effects of increased cortical damage on bone in mature rabbits**

Charlene Sugay  
Texas A&M University

PURPOSE: To investigate how the amount of cortical damage affects bone adjacent to osteoperforations (OP). METHODS: Using a split-body design, tibias of 10 skeletally mature rabbits were randomly allocated to receive 1 (control) or 4 (experimental) OPs. Sacrifice occurred 2 weeks later. RESULTS:

Control bone was denser ( $\mu$ CT) and harder (Vickers) than experimental bone. H&E sections showed more woven bone within control OP sites, and greater unmineralized fibrous tissue in experimental OP sites. Control and experimental bone surfaces also displayed relatively greater amounts of woven bone and fibrous tissue, respectively. There were acellular areas directly adjacent to the OPs, extending up to 0.9 mm from the OPs. TRAP staining indicated significantly greater osteoclastic activity in the experimental than control group up to 1.0 mm away from the OPs. **CONCLUSION:** Greater amounts of surgical damage substantially reduces the rate of OP healing and the quality of bone adjacent to OPs.

## **Clinical Research**

### **Long-term effects of various cleaning methods on clear retainer materials**

Manika Agarwal  
University of Illinois - Chicago

Background: Clear retainers have become popular but there is no evidence-based method for their maintenance. Purpose: Evaluate the long-term effects of cleaning methods on clear retainers. Research Design: Viverra® and Essix® ACE specimens (n=10) were exposed to Invisalign® cleaning crystals, Polident®, Listerine®, vinegar, NaClO, H<sub>2</sub>O<sub>2</sub>, and toothbrushing with water twice a week for 6 months. Light transmittance, surface roughness, flexural modulus and scanning electron microscopy of specimens were analyzed at 0 and 6 months. Mean differences were analyzed using student t-test and ANOVA at P=0.05. Results: Significant results showed a decrease in transmittance in all methods after 6 months with the greatest decrease in Viverra® by toothbrushing and in ACE by Listerine®. Vinegar and toothbrushing increased stiffness of Viverra®, and all methods except Invisalign® cleaning crystals increased stiffness of ACE. Conclusion: There is no ideal long-term maintenance method for clear retainers.

### **Altered craniofacial morphology in children with OSAS: a clinical photographic study**

Evan Ayers  
University of British Columbia

With a reported prevalence of up to 5%, pediatric OSAS is a common childhood affliction. Altered craniofacial morphology such as retrognathic jaws, vertical growth, and long narrow faces have been associated with pediatric OSAS. The purpose of our study was to assess the impact of altered craniofacial morphology in children undergoing overnight PSG, comparing their PSG results with the data from their orthodontic exam and from calibrated digital photographs. 65 participants (29 f, 36 m, age  $8.9 \pm 3.1$  years) were compared on their AHI. 27 children had an AHI < 2/h, while 37 had an AHI >2/h (OSAS). After controlling for gender, age and obesity, it was found that more children with OSAS had larger tonsils (3+) than children without OSAS (39% vs. 13%,  $p < 0.05$ ), lower crowding >3 mm (32% vs. 13%;  $p < 0.05$ ), and a more obtuse cervico-mental angle ( $129^\circ$  vs.  $122^\circ$ ;  $p < 0.05$ ). Aside from these findings, altered craniofacial morphology was not significantly associated with pediatric OSAS.

### **Retention of an orthodontic nanofilled glass-ionomer sealant: a prospective, randomized controlled clinical trial**

Nicholas Booth  
University of Oklahoma

The purpose of this study was to evaluate the retention of a new resin in subjects during orthodontic treatment. M&M: The sample included 148 patients randomly divided into 2 groups: Opal® Seal (n=79) and Control (n= 69). The 79 patients in the OS group were then randomly divided into the One Time group (OSOneTime) and Reapply group (OSReapply). At bonding and approximately every 3 to 4 months into treatment photographs of the maxillary anterior teeth were taken under a black light and were evaluated by Image Pro Premier software. Results: There was a statistically significant sealant loss of 22.3% for all maxillary anterior teeth in both sealant groups at the end of initial 4 months. After 12 to 13 months in treatment, the difference was 13.4% between the OSOneTime and the OSReapply groups with

the teeth in the OS Reapply group showing better coverage. Conclusions: The results indicated a significant loss of sealant during the first 3-4 months of orthodontic treatment.

### **Compliance monitoring via a bluetooth enabled retainer: a prospective clinical pilot study**

Eric Castle

University of California - San Francisco

Introduction: The objective was to test the clinical efficacy and accuracy of a newly developed Bluetooth enabled retainer and iOS mobile application. Methods: Five subjects were given an Innov8 Retainer, logbook and iPod Touch with the Innov8 mobile application (T0). Subjects were instructed to wear the retainer for 12 hours per day, record each time the retainer was inserted or removed and trained to sync the device daily to the mobile application. After the five-day study period (T1), statistical analysis was performed. Results: From T0 – T1, subjects wore their retainers a median of 11.55 hours per day. The median difference between the self- and device-reported data was 35 minutes or 5.1% and 13 minutes or 1.9% using the adjusted calculation method. Conclusions: Subjects were able to successfully wear the retainer and use the mobile application. The device showed a clinically acceptable level of accuracy and usability that validates it for further clinical testing.

### **Effectiveness of a lingual arch as maximum anchorage in orthodontics**

James Cavalancia

Temple University

Background:Lingual arches are frequently used in orthodontic extraction treatment to achieve maximum anchorage in the mandibular arch; however, little evidence exists in the literature that supports this anchorage approach. Purpose:To examine anchorage capacity of the lingual arch by comparing incisor and molar position in extraction treatment with and without the use of a lingual arch. Research Design:Pre and post-treatment cephalograms of 25 patients who received extraction treatment with and without a lingual arch were traced and compared using measurements of IMPA, L1-NB, L1-APog and mesialization of the molar. Results:No statistical difference between the lingual arch and non-lingual arch groups for any of the measurements. Conclusions:Changes in incisor and molar position do not significantly differ with or without the use of a lingual arch in extraction treatment, suggesting that the lingual arch does not provide maximum anchorage for extraction treatment in the mandibular arch.

### **Comparison of surgical & non-surgical orthodontic treatment approaches in patients with severe Class II Division I malocclusions**

Sheila Daniels

University of Iowa

This study aimed to examine end-of-treatment outcomes of severe Class II Division I malocclusion patients treated with surgical versus non-surgical approaches. This study tests the hypotheses that occlusal outcomes (ABO-OGS) at the end of treatment will be similar and cephalometric outcomes will differ between surgical and non-surgical treatments. A total of 60 patients were included: 20 of which underwent surgical correction and 40 of which did not. The end of treatment ABO-OGS and cephalometric outcomes were compared by Mann-Whitney U tests and multivariable linear regression models. Results showed significant differences in final ABO deband score, deband ceph overbite, and final ANB, FMIA, IMPA, and U1 to SN Plane angles. Therefore we can conclude that differences exist between the two groups in these areas. Funding Source: This study was funded by a biomedical research award sponsored but the American Association of Orthodontists Foundation.

### **Validity and reliability of computerized automatic identification of dental landmarks**

Nora Dolatabadi

University of the Pacific

Background:With advances in computer technology, 3dimensional dental cast imaging have been widely used in orthodontics. Purpose:To evaluate the reliability and validity of Quantify™ software as a tool for automatic landmark location. Research design:Using pre-treatment digital intraoral scans of 5 patients, 4

calibrated judges located 84 landmarks on maxillary and mandibular arches. The measurements were recorded in X, Y, and Z coordinates. Separately, the same landmarks were automatically identified by the software. Results: We conducted a parallel forms reliability test to analyze and test the two sources (humans vs. software) for reliability and consistency. ICC for X, Y, and Z coordinates was 0.990, 0.999 and 0.993 respectively, thereby establishing the inter-rater consistency. Conclusion: Inspection of the consistency between the software and the average of human raters showed that the two sources are virtually identical. The methods appeared to be interchangeable with each other

### **A quantitative assessment of the costs associated with orthodontic collection practices**

Victoria Duong

Roseman University of Health Sciences

Introduction: This study assesses the cost of extending credit to orthodontic patients. Methods: Five collection groups with 10 payment simulations were constructed. Group 1 (Control) = Full payment: cash and credit card (CC) payments. Group 2 = Cash expediting: Full cash payment at 10% discount and CareCredit. Group 3 = Traditional financing: 20% down payment (DP) with cash and CC payments. Group 4 = Alternative financing: 0% DP. Group 5 = Alternative financing with extension of payment term: three additional months. Financial analyses, Present Value (PV) and Net Profit Margin (NP%), were performed. Results: The PVs and NP% respectively are: Group 1 = \$5494, 41% (Cash) and \$5346, 38% (CC); Group 2 = \$4944, 31% (Cash) and \$4678, 26% (CC); Group 3 = \$4913, 30% (Cash) and \$4831, 27% (CC); Group 4 = \$4794, 27% (Cash) and \$4675, 25% (CC); Group 5 = \$4738, 26% (Cash) and \$4631, 20% (CC). Conclusions: Under conservative estimations, full cash payment with discount yielded highest PV and NP%.

### **Morphological simulation of different incisal embrasures: perception of laypersons, orthodontic patients, dentist and orthodontists**

Maria Eduarda Duarte

Universidade Federal Fluminense

Tooth morphology has great impact on smile aesthetics, and incisal embrasures are subject to adjustments so as to achieve better results. Purpose: Evaluate the aesthetic perception of each group on different forms of incisal embrasures. Research Design: Two photographs of smiles were manipulated to simulate 3 different forms of incisal embrasures on the maxillary incisors. The upper lip was shifted down to simulate different gingival display. The evaluators were divided into four groups: laypersons, orthodontic patients, dentists and orthodontists. Statistical analysis: Multiple Factor ANOVA; Tukey's post-test. Results: The semi-rounded form was generally preferred. Gingival display had a statistically significant influence on how the embrasures were perceived. Orthodontists were the most stringent. Conclusions: The form of incisal embrasures and gingival display influenced aesthetic perception. There was a statistically significant difference between patients and orthodontists.

### **Obstructive sleep apnea is associated with reduced mandibular cortical thickness in children**

Hazem Eimar

University of Alberta

Purpose: Thin mandibular cortical width (MCW) has been strongly linked to low bone density. Preliminary evidence suggests that bone growth and mineralization may be adversely impacted by the presence of obstructive sleep apnea (OSA). We hypothesized that MCW would be thinner in children with OSA compared to healthy children. Methods: MCW was retrospectively determined from panoramic radiographs of 27 children with OSA, and 81 age- and sex-matched children without sleep disordered breathing (SDB) signs. Factorial analysis of variance was used to compare the study outcomes between the 2 groups. Results: Increases in MCW values emerged with increasing age in both OSA ( $R=0.72$ ,  $p<0.01$ ) and control children ( $R=0.66$ ,  $p<0.01$ ). However, MCW readings were significantly lower in OSA children ( $3.1\pm 0.06\text{mm}$ ) compared to control children ( $3.6\pm 0.06\text{mm}$ ;  $p<0.05$ ). Conclusions: The present results suggest that children with OSA may have thinner mandibular cortex compared to children with no report SDB

### **Upper airway structural responses to hypoglossal nerve**

Tarek Elshebiny

Case Western Reserve University

Upper airway stimulation of the hypoglossal nerve (UAS) is a novel option for patients with obstructive sleep apnea (OSA). Our aim is to evaluate pharyngeal changes in patients using UAS. Methods: Seven UAS patients underwent CBCT scans collected during a) regular breathing, b) active UAS, and c) +10cmH<sub>2</sub>O CPAP mask. Nasopharynx, oropharynx, and hypopharynx volumes, hyoid bone position, and tongue length were measured. Results: All airway volumes increased progressively from breathing, CPAP, and UAS. Regular breathing showed significantly lower airway volumes than both CPAP and UAS ( $p < 0.05$ ). UAS showed a significantly larger oropharynx than the CPAP. Hyoid bone movement only happened with the UAS, showing an upward and forward movement. Tongue length decreased with UAS, but showed no change with CPAP. Conclusions: UAS of the hypoglossal nerve results in a larger oropharynx opening, hyoid bone movement, and tongue length decrease, suggesting a more physiological and active approach.

### **Skeletal Class III, lateral incisors agenesis and bilateral canine-bicuspid transposition - case report**

Verónica García-Sanz

University of Valencia

Background: Skeletal Class III, lateral incisor agenesis and transposition represent a range of anomalies which are challenging to treat. An accurate diagnosis is crucial in order to choose the correct treatment option. Purpose: To describe the orthodontic treatment of a skeletal Class III combined with other dental anomalies such as tooth agenesis and transposition. Research Design: A case report of an adolescent with skeletal Class III, missing lateral incisors and transposition of maxillary canines and premolars is presented. Dentoalveolar compensation of the Class III was performed. Upper lateral incisor spaces were closed, so the first premolars replaced the missing laterals, maintaining the transposition. Results: Satisfactory results were obtained in terms of function, occlusal stability and aesthetics. Conclusion: This case demonstrates the importance of an accurate diagnosis when many treatment options are available in cases with a combination of dental anomalies.

### **Evaluation of variables affecting orthodontic treatment time**

Mélanie Gauthier

University of Montreal

The objective of this study was to evaluate and quantify the variables that may influence orthodontic treatment time. The study included records of 300 retention patients who were treated at the University of Montreal Orthodontic Clinic. The following variables were noted: patient's age and sex, the clinical and radiological data related to the malocclusions, the elements used in the planning and execution of treatment and the degree of patient cooperation. Uni-varied analyses (chi-square, t-test and ANOVA) were used to identify variables that affect treatment time. Subsequently, a multiple regression analysis was used to build a model to predict the treatment time. This study revealed that the duration of orthodontic treatment is influenced by the following factors in order of importance: extraction(s), cooperation, initial malocclusion, adhesive and resin products, bracket type, clinician's age and patient gender.

### **A novel method to measure the clinically relevant edgewise slot**

Alfred Griffin

Harvard School of Dental Medicine

Background Past studies, using single point-to-point measurements, reported that most MIM, milled and cast metal brackets have a slot accuracy within 1 mil of their reported slot dimension. These methods have not accounted for bracket slot divergence. Purpose We test the hypothesis that various MIM and CIM manufactured brackets have a slot accuracy within 1 mil of their reported value by our newly defined methods. Research Design A laser microcope with 0.1 $\mu$ m resolution was used to measure slots of 6 CIM

series and 2 MIM series, (N=100/series). Slots were auto-focused by a blinded operator, and 40 point-to-line measurements were averaged. Results A MIM series and 3 of 6 CIM series had a significant mean slot size 1 mil larger than reported. Bracket precision, as determined by stddev, varied from series to series. Conclusion Many MIM and CIM brackets have a slot size greater than 1 mil. Our data suggest that slot divergence contributes to reduced vertical slot accuracy and precision.

### **Accuracy and performance of novel 3D metal printed orthodontic brackets**

Christina Jackson  
University of North Carolina - Chapel Hill

3D metal printing is an emerging technology with potential to streamline bracket production for personalized and precision orthodontics. We hypothesized that the dimensional accuracy and shear bond strength (SBS) of the 3D metal printed brackets are comparable to that of conventionally manufactured brackets. A novel .022 inch bracket was 3D printed in 316-SS and compared to two commercially available bracket systems (N=35 per system). Slot dimensions and SBS were measured by a stereomicroscope and Instron, respectively. A one-way ANOVA and Tukey-Kramer HSD were used for statistical analysis. The 3D printed slot (.0233±.001in.) was found to be more accurate than control bracket slots (Damon=.0247±.001in.; Ti-Orthos=.0244±.005in.) (p<.001). There was no difference in the SBS of the three systems (p=0.9). It can be concluded that 3D metal printing produces a more accurate slot with equivalent SBS. Our data support the use of 3D metal printing for orthodontic bracket manufacture.

### **Effect of supplemental vibration on orthodontic treatment with aligners**

Mina Katchooi  
University of Washington

Background: Supplemental vibration has been introduced to orthodontics to reduce treatment time. Purpose: To investigate the effects of Acceledent® on Invisalign®. Design: This multi-center double-blind controlled clinical trial was carried out in 2 practices in Seattle, WA and Vancouver, BC. 26 adults (mean age= 33,12 male,14 female) were randomly allocated to 1 of the treatment arms: active vs. control. All subjects were placed on a 1-week regimen for changing aligners. Results: Fisher's exact test showed no significant difference in the percentage of subjects who successfully completed the initial treatment between the 2 groups (p=1). Independent-sample t-test showed no significant difference between end of treatment incisor Irregularity Index (p=0.75) and change in II (p=0.74) between the 2 groups. Conclusions: The study found no evidence that Acceledent® impacts the ability to complete a series of aligners with a 1-week change regimen or the final alignment achieved. (NCT02438280)

### **Orthodontists' and parents' perspective of treatment outcomes in varying sagittal positions**

David Lindsey  
Virginia Commonwealth University

Objective: The purpose was to compare orthodontists' and parents' perception of treatment outcomes in the anterior-posterior (AP) dimension. Material and Methods: Parallel surveys for orthodontists (n=1000) and parents (n=750) displayed a range of occlusions from 3mm Class III (CI III:3) to 3mm Class II. Participants rated occlusal relationships on a 100mm VAS anchored by least to most acceptable (0-100). Results: 233 orthodontists (23%) and 243 parents (32%) responded. Orthodontists (VAS mean=93.9) and parents (VAS mean=80.7) rated Class I (CI I) occlusion highest. Orthodontists viewed CI I and 1mm Class II more acceptable than parents (estimated differences=13.2±1.11, 12.7±1.56). Parents did not statistically differ in rating CI I and 1mm Class III (VAS mean=80.7, 78.7). CI III:3 was rated least acceptable by both orthodontists (VAS mean=25.9) and parents (VAS mean=40.9). Conclusions: Orthodontists and parents viewed orthodontic treatment outcomes in the AP dimension differently.

### **Dental effects of the NiTi Memoria (R) leaf spring activated expander**

Kevin Manzella  
State University of New York - Buffalo

This retrospective controlled clinical study evaluated the dental effects of the NiTi Memoria (R) Leaf Spring activated expander in adolescent patients (12.75±3.01 years). Pretreatment and post-expansion digital dental casts of 21 treated and 21 matched controls were evaluated for maxillary dental arch measurements. The mean expansion duration was 6.2 months. Significant differences were found between baseline and final intercanine, inter-first and second premolars, intermolar, arch depth and arch perimeter measurements in the treatment group. No significant differences were found for the controls. Between group analyses showed highly statistically significant differences between the treatment and control groups for all variables except for arch depth. Average changes for intercanine, inter-first premolar, inter-second premolar, intermolar, and arch perimeter were 1.33, 5.98, 6.10, 4.97 and 2.53mm, respectively.

### **Stereolithographic material accuracy for orthodontic models printed on the stratasys Objet Eden260V™**

Kevin Menzie

Uniformed Services University of the Health Sciences

The Objet Eden260V™ was used to compare precision and accuracy of orthodontic study models printed in various materials. Seven Polyjet materials were selected and eight models of each were printed. Models were labeled according to a pre-defined scheme and digitally scanned. Models were compared to the control by using digital overlays on three-dimensional software. Statistically significant differences ( $p<0.01$ ) were found at Group B (670 VeroDent) for the average differences outcome variable. Group B was also the most accurate, second most precise, and most economical choice. Caution should be exercised when electing to print dental models on the Eden260V™, as average differences can reach beyond 100 microns and may lead to poor thermoplastic retainer fit and/or model articulation challenges. Further comparative investigations of other printing platforms is warranted.

### **Bending properties of aesthetic-coated orthodontic archwires**

Deise Oliveira

Georgia School of Orthodontics

Background: Patients aesthetics demands the use of aesthetic wires. Purpose: Evaluate in vitro the 3-point bending properties of aesthetic archwires (AW). Design: 60 round 0.014-inch AW (n=10): [TC] Titanol® Cosmetic (Forestadent®, USA), [FS] Flexy®NiTi Esthetic (Orthometric®, BR), [RT] Reflex® NiTi (TP Ortho, Inc., USA), [CN] Cosmetic NiTi (Tecnident, BR), [BK] Bio-Kinetix® Thermo® (Ortho® Organizers, USA) and [NS] Unitek™ NiTi (3M, USA). TC, FS and RT are polytetrafluorethylene coated; CN and BK are epoxy resin-coated and control group was NS. AWs on metal brackets were fixed on a metal block, Instron. Deflection was measured to 2.1 mm for each AW at a speed of 1mm/min, 50N. Deactivation was obtained at 4 deflections: 0.5, 1.0, 1.5 and 2.0mm. ANOVA and Tukey's test ( $\alpha=0.05$ ). Results: CN showed higher values, while BK showed lower values for all deflection ( $p<0.05$ ). Conclusion: Deflection is dependent on the AW type. Higher deflection extensions cause higher forces for all materials.

### **Modified unilateral pendulum appliance for distalising first & second molar in adult patient : a case report**

Brijesh Patel

Madhya Pradesh Medical Science University

**INTRODUCTION** Treatment of unilateral class II cases has always been. Recent development in mechanotherapy has reduced need for extraction **MATERIAL & METHOD** A male patient of 24 years with angle's class II subdivision. A Modified unilateral pendulum appliance was fabricated Anchorage loss was determined by measuring incisor and premolar movement. Therefore, centroid points were determined for the crowns .According to Kinzinger we measured the sagittal movement of teeth vertical to the pterygoid. To examine the transverse changes, the distances between the mesio & distobuccal cusp tips of the first molars & the raphe median line were measured. **Result** Both distal movements between T1 & T2 were significant. The mean amount of the first molar & second molar distalization was 9.83 mm,

with distal tipping of 4° & 8.83 mm & distal tipping 16.7° **DISCUSSION** In our case report we derived remarkable finding of no anchorage loss by unilateral pendulum appliance

### **The effect of maxillary features and occlusal parameters on /sh/ sound production in control and glossectomy subjects**

Andrew Pedersen  
University of Maryland

This study examines the process by which the tongue articulates speech in glossectomy (N = 14) and control (N = 17) subjects using high resolution and cine-MRI. Multiple variables are assessed in both groups to see any effect on the amount of tongue volume displaced when contacting the anterior palate. This volume amount is termed anteriority and measured against multiple variables. The independent variables include palate height, intercanine width, arch perimeter, orthodontic bicuspid extraction, overbite and overjet. The speech task of each subject is the sound /sh/ from a repeated word task. Results of the study showed statistically significant ( $p \leq 0.05$ ) differences in anteriority between glossectomy patients and controls, large versus small overbite, and an interaction between subject type and overbite. Data suggests having a larger overbite decreases the oral cavity size during /sh/ speech and therefore increases tongue anteriority, especially in glossectomy subjects.

### **Long-term effects of nasoalveolar molding in patients with complete unilateral CLP**

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Background-Nasoalveolar molding (NAM) is a popular approach of infant orthopedics, the effects of which have not been adequately studied. Purpose-To investigate the long-term nasolabial esthetic outcome of NAM in comparison to traditional infant orthopedics (TIO) and to no IO for patients with complete unilateral cleft lip and palate (CLP) between the ages of 10 and 14 years. Research Design-Three samples were retrospectively collected, each having been treated with a different infant protocol, namely NAM (n=37), TIO (n=39), and no-IO (n=33). Nasolabial esthetics were assessed based on photographs using the Q-Sort modification of the Asher-McDade method. The Kruskal-Wallis test was used for statistical analysis. Results-NAM and TIO resulted in significantly superior results in vermilion border and frontal nasal form when compared to no IO. TIO led to significantly more esthetic nasal profiles compared to NAM or no IO. Conclusions-IO may have long-term benefits for patients with CLP.

### **Skeletal and soft tissue changes in orthodontically treated anterior open bite**

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Background:Anterior OpenBite(AOB)can result from genetics,digit sucking or mouth breathing.South Bronx is the poorest district in the nation. A socioeconomically depressed environment may lead to selfsoothing with nonnutritive sucking habits.Processed foods containing allergens may lead to enlarged adenoids and airway obstruction necessitating mouth breathing.Purpose:To study characteristics of AOB in our patients, to evaluate treatment outcomes and to use our findings as predictors of achievable results.Research Design:A retrospective study of chart review of patients with AOB. 28 subjects with AOB who had non-surgical treatment were selected. Pre and Post Cephalograms, T1 and T2 respectively were traced.Results:24 parameters were measured pre and post treatment.T-test will be used for analysis. Conclusion:One can envision using data collected to create computer algorithms to predict outcomes and determine whether a particular case is best treated surgically or non-surgically.

### **Lack of pulpal sensitivity in ectopic maxillary canines after orthodontic treatment**

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Introduction: Orthodontic treatment to correct ectopic canines can be related to pulp necrosis. Objective: This study investigated if ectopic canines were predisposed to lack of sensitivity after orthodontic

treatment. Materials and Methods: Forty maxillary canines were divided into two groups: ectopic (n=26) and non-ectopic (n=14). Their axial angulation and distance to the occlusal plane were measured. Pulp assessment included thermal, electrical, and percussion tests. Results: Although the mixed-effects logistic regression model showed no statistically significant difference with regard to lack pulp sensitivity ( $p>0.0744$ ), twelve ectopic teeth (46.15%) presented no sensitivity in comparison to only two (14.29%) non-ectopic teeth. The Kruskal-Wallis test detected no influence from axial angulation ( $p>0.0661$ ), distance ( $p>0.4840$ ), and traction duration ( $p>0.4037$ ). Conclusion: Lack of pulp sensitivity can be a post-orthodontic side effect, but further studies are necessary.

### **The correlation between malocclusion and noted speech abnormalities**

Sydney Simpson  
Howard University

Introduction: The purpose of this study was to identify which malocclusions have the highest positive correlation with abnormal speech and to identify the orthodontists comfort level with identifying abnormal speech. Methods: 100 patient charts with noted speech abnormalities were obtained from the Howard University Department of Orthodontics and specific factors, including malocclusion, oral habits and age were noted. Also a survey was sent to 2300 practicing orthodontists and orthodontic residents through the AAO assessing the practitioners comfort level with pathological speech identification. Expected Results: There is a relationship between malocclusion and pathological speech, with anterior open bite being one of the main factors correlated to the need for speech therapy.

### **Force-system of V-bends: a three dimensional analysis of wire size and activation**

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Background: Previous analysis of V-bend mechanics has been 2 dimensional, although orthodontic appliances are 3 dimensional (3D) in nature. Purpose: To produce clinically relevant data for the force system with V-bends placed in stainless steel archwires of 4 different sizes. Research design: Three V-bend angles of 12°, 20° & 30° placed at 11 different locations obtained from a theoretical framework from previous data was used. Multi-axis force transducers mimicking a 2x4 appliance were used to measure the force-system in the x, y & z planes. Results: The data obtained did not conform with the previous 2D studies. The force system increased at the two brackets ( $P<0.05$ ) with increasing wire size & activation. Torsional & bending moments created unique force systems at each bracket. Conclusions: This 3D analysis provides critical information on V-bend activation & application .A model for determining the force system is described that will allow for easier translation of the data to actual clinical practice.

### **Pharyngeal airway space changes after condylar replacement surgery**

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Introduction: Purpose: examine the total volume and cross-sectional areas of the pharyngeal airway after bilateral condylar replacement surgery. Materials and Methods: Subjects (126 females, 11 males) had bilateral condylar replacement by one surgeon. Oropharyngeal airway space volume and minimum cross-sectional area measurements were taken on CBCT's pre-operatively -T1, post-operatively -T2, and one year after surgery -T3 with InVivoDental 3D imaging at the level of C1, C2, and C3 cervical vertebrae. Results: Increases shown in all measurements, T1-T3 ( $p<0.05$ ); moreover, significant differences in cross-sections at C1 & C2 as well as minimum cross-sectional area with age. Inter-operator measurements correlated significantly. Conclusions: Patients show an increase in pharyngeal airway space after bilateral condylar replacement surgery (T3). Also, age was found to be significantly associated with cross-sectional areas of the airway, with older patients having smaller values.

### **The effect of maxillary protraction on the eruption of permanent maxillary canines**

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Maimonides Medical Center

Introduction: Maxillary protraction facemask therapy is an orthodontic treatment modality used to correct retrusively-positioned maxillas in growing patients. This treatment is typically done during the mixed dentition prior to the eruption of the permanent maxillary canines. The overall aim of this study is to determine if facemask therapy has any effect on the eruption path of these teeth. Methods: Panoramic radiographs of 15 subjects who underwent facemask therapy and 15 controls matched to subjects by age and sex were included. Angular measurements and a sector analysis were used as a means of comparison between the two groups. Results: There was no statistical difference found between the two groups for both sector analysis and angular measurement. Conclusion: Maxillary protraction facemask therapy does not appear to have an effect on the eruption of the permanent maxillary canines, but further research with larger sample sizes will be needed to confirm this finding.