Celebrating Excellence and Achievement in Research

2017–2018 Research Abstracts
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HISTORY OF BATES-ANDREWS DAY

Since the 1930s, this day is held annually to honor George A. Bates, an alumnus of Tufts University School of Dental Medicine (TUSDM), who taught Tufts medical and dental students. He was regarded by his students as an inspiring instructor in histology. Bates Day at TUSDM helps to promote student research and thereby enhance the opportunities for professional growth of our students, alumni, and faculty.

The Robert R. Andrews Society is a student-run organization formed in 1921 in honor of Dr. Andrews, an outstanding researcher and distinguished dental surgeon. The Andrews Society seeks to promote dental research and to honor those who excel in it.

MESSAGE FROM DR. KUGEL

The research mission of Tufts University School of Dental Medicine promotes integration of innovative studies in basic science, clinical practice, and public health. This book is evidence of the progress we have made and will continue to make at the Dental School.

TUSDM welcomes the valuable partnerships and contributions of corporations, foundations, the NIH, and the NIDCR. Working together, we have the means to perform ethical, meaningful research in oral and general healthcare that can be applied for the benefit of the scientific community and the public at large.

Researchers at TUSDM conduct studies in many areas, including bench and clinical studies in dental materials, devices, and pharmaceuticals. We are presently pursuing groundbreaking techniques in many areas, including tissue engineering, bone remodeling, and Sjögren’s syndrome. Our dental school is widely recognized as a leader in public health dentistry both in the United States and worldwide. Tufts University School of Dental Medicine also provides a wealth of opportunities for interdisciplinary research with our schools of nutrition, biomedical sciences, veterinary medicine, and engineering.

The combination of disciplines and talent at Tufts University provides the ideal environment for collaborative research and materials testing. Our record of contributions to the sciences and our potential to influence the future of dental medicine are extensive.

As we continue to promote oral health and improve the quality of life for the general population, we remain aware that strategic partnerships are vital to our efforts. We recognize the power of shared knowledge and are always looking to share resources and ideas. The pages that follow reveal a sample of our achievements thus far.

Gerard Kugel, D.M.D., M.S., Ph.D.
Professor and Associate Dean for Research
Bates-Andrews Day 2018
Wednesday, March 7, 2018

MESSAGE FROM THE DEAN

Welcome to Bates-Andrews Day 2018, a showcase of our predoctoral and postgraduate students’ research activities. This year’s event will be the second largest, with 78 student poster presentations. We appreciate your attendance and support of our students’ efforts.

Bates-Andrews Day gives our students the opportunity to share with the rest of the Tufts community their accomplishments in fields of special interest. I applaud them for their initiative and achievements.

Strengthening and increasing research activity and creating an environment that encourages and supports student participation in research are integral parts of the School’s strategic plan. Student research is also a key accreditation standard for dental education programs.

I appreciate the dedication of the faculty advisors for their mentorship. Special thanks go to the judges, the commercial exhibitors, and the Office of Alumni Relations, all of whom help make this event a success. Finally, Eileen Doherty’s guidance as director of predoctoral student research and Dr. Gerard Kugel’s leadership as associate dean for research are highly valued as their efforts enhance our students’ research experiences.

Huw F. Thomas, B.D.S., M.S., Ph.D.
Dean and Professor of Pediatric Dentistry
ACKNOWLEDGEMENTS

Corporate Partners

We would like to recognize and thank the following organizations or individuals that support us:

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Special thanks to the following Tufts faculty and students:

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Dr. Natalie Jeong
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BATES-ANDREWS RESEARCH DAY 2018
BATES-ANDREWS DAY 2018 AWARDS

Best Postgraduate Poster Presentation

Dr. Pooyan Refahi (Periodontics)—“Minimally Invasive Mucogingival Procedures: Assessing the Level of Evidence”

Best Scientific Research Presentation by a Senior (Andrews Society Award)

Timothy Reichheld—“Evaluation of Monobond Plus® with SpeedCEM® Plus for Orthodontic Purposes”

AADR/DENTSPLY Sirona Student Competition for Advancing Dental Research and Its Application

Grace Kim—“Storage Temperature Effect on Fluoride Varnishes: Bioavailable Fluoride and Viscosity”

Second Place Award for Predoctoral Table Clinic

Stanley Ojukwu—“Treatment of Severe Odontogenic Infection: Antibiotic Management Preferences of Oral Surgeons”

Third Place Award for Predoctoral Table Clinic

Annie Rao—“Assessing the Usage and Confidence in Oral Cancer Screenings at Tufts University School of Dental Medicine”

Research Committee Award for Basic Science Research

Sara Mir—“Delineating Epithelial-Stromal Interactions in Basal Cell Carcinoma Development”

Massachusetts Dental Society and ASDA Public Health Award

Kaitlyn O’Connell—“A Survey of Caregivers Regarding Dental Care for Autistic Children”

Omicron Kappa Upsilon (OKU) Hilde Tillman Award


Dr. Chad Anderson Family Award for Innovative Methodology and Research

Syed Hussain—“Does Disinfecting Extracted Teeth with NaClO Affect Shear Bond Strength?”

Esthetic Dentistry Award

Jesse Feuerstein and Tyler Beninati—“Evaluation of Cementum Permeability and Microleakage with Different Bonding Systems”
Scientific Merit Award for First-Time Presenters
David Michaels—“Material Flexural Strength Comparison Using Marketed and Experimental Automix Tips”

Bates Student Research Group “Peer-Reviewed” Award
Mythilee Kugathasan—“Is There a Reduction in Facial Swelling When Intraoperative Corticosteroids Are Used?”

ADEA Student Group Educational Research Award
Benjamin Smith—“Perspectives on the Use of Learning Catalytics in the Curriculum”

Procter & Gamble AADR Traveling Fellowship Award
Craig Holliday—“Treating Hyposalivation: Efficacy and Adverse Effects on Pilocarpine vs. Cevimeline”

AADR Student Research Day Award
Delaney Turner—“Clinical Performance of CAD/CAM Generated All-Ceramic Crowns”

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Analysis of Negative Perceptions during Dental Treatment That Trigger Anxiety—Using the Apple ResearchKit Platform: A Pilot Study

David Abazari, Tamar Roomian, Ronald Perry, Yun Saksena

BACKGROUND: Dental fear and anxiety (DFA) can present a prohibitive barrier for patients seeking treatment and routine dental care. In creating new strategies to limit DFA, the quality and quantity of data collection is crucial. Historically, data has been collected through paper and email surveys.

OBJECTIVE: We seek to use technological advances in an online tool to test the capacity of data collection on a global scale. Apple’s ResearchKit platform, introduced in 2013, is a coding tool to help developers create research applications that are streamlined for Apple devices and easy to use for patients. With over one billion Apple users worldwide, the sheer volume of active devices has proven to be an asset for data collection applications on the Apple App Store. Upon completion of this study we aim to demonstrate ResearchKit as a viable and potentially better alternative to other web-based and paper forms of survey data collection in oral health research.

METHODS: Ten validated survey questions were adopted from the Faces version of the Modified Child Dental Anxiety Scale (MCDAS(f)), a self-reporting measure used to quantify DFA in relation to typical dental situations like local anesthesia and prophylaxis. In addition, seven demographic questions will be included for further analysis. We estimate up to 500 respondents in six months from the application publication with no marketing. Participant demographics and anxiety responses from application will be summarized using frequencies and percentages for categorical data and mean, standard deviation, and range for continuous variables. Anxiety responses collected using the application will be summarized and compared against previous literature cited using MCDAS(f) surveys using two-sample t-tests and chi-squared tests.

RESULTS: Our goal is to begin data collection in May, 2018.

CONCLUSION: Upon completion of this study, we aim to demonstrate Apple ResearchKit mobile apps as a viable and potentially better alternative to other web-based and paper forms of survey data collection due to greater efficiency and broader access to patient populations.
Identifying Diagnostic Salivary Biomarkers for Sjögren’s Syndrome

Sama Abdul-Aziz,1* W. Qu,2 Dillon Hawley,1 Arwa Farag,1 Noe Duenas,1 Britta Magnuson,1 Elizabeth Tzavaras,1 Athena Papas,1 M. Hardt,2 and Driss Zoukhri1
1Tufts University, Boston; 2The Forsyth Institute, Cambridge, Massachusetts

OBJECTIVES: Although Sjögren's syndrome (SjS) is a prevalent autoimmune disorder, confirming the diagnosis remains difficult to achieve due to the lack of definitive diagnostic methods. Development of protein biomarker profiles would allow for a highly sensitive and specific diagnostic method. By comparing the proteomes of individuals with and without SjS, alterations in the composition of the salivary proteome can be observed and potential biomarkers identified. The purpose of this study was to determine which proteins could be considered as biomarkers for SjS diagnosis.

METHODS: For the study, 21 SjS patients and 18 age-matched healthy controls were recruited. Stimulated whole saliva was collected. One hundred µg of protein was trypsin-digested and alkylated. Digests were desalted for proteomics analysis using nano LC-MS/MS. Multiple search algorithms were used for protein identification. Label-free quantitative analysis was performed using Sieve 2.2 software. For validation, 10 µg of five SjS and five healthy samples were separated by SDS-PAGE followed by transfer to PVDF membranes for Western blotting. Immunoreactive bands were visualized and quantified using the Odyssey® Infrared Imaging System.

RESULTS: SjS and healthy subjects' demographics are summarized in Table 1. Unstimulated and stimulated salivary flow rates were lower for patients diagnosed with SjS compared to healthy subjects. Using nano-LC-MS/MS, over 1,057 proteins were identified across the samples at a 1% false identification rate. Multiple search engines boosted the identification rate. After chromatographic alignment, MS-features were detected and their peak areas were determined. Thirty-five protein candidates showed significant differences between SjS and healthy samples.

CONCLUSION: Candidate proteins were identified that differ in their abundance in stimulated saliva samples collected from SjS and healthy patients. Select candidate proteins are currently being validated by Western blotting to verify whether these proteins can be included in the development of a protein biomarker profile to be used as a non-invasive method of SjS diagnosis.

Table 1. Summary of patients’ characteristics

<table>
<thead>
<tr>
<th></th>
<th>SjS (N=24)</th>
<th>Healthy (N=18)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age1</td>
<td>57±10 (35–67)#</td>
<td>54±7 (45–68)#</td>
</tr>
<tr>
<td>Sex (F/M)</td>
<td>(24/0)</td>
<td>(18/0)</td>
</tr>
<tr>
<td>Disease Duration2,3</td>
<td>8±5 (2–20)#</td>
<td>N/A</td>
</tr>
<tr>
<td>Salivary flow rate4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unstimulated</td>
<td>0.264±0.286</td>
<td>0.735±0.339</td>
</tr>
<tr>
<td>Stimulated</td>
<td>0.949±0.816</td>
<td>2.178±0.896</td>
</tr>
</tbody>
</table>

1Median (years)±SD. 2Since diagnosis. 3Mean (years)±SD.
4Mean (mL/min)±SD. 5Range (years)
**Color Stability and Stain Resistance of Composite Materials**

*Daria Ameri,* Jeffrey Daddona, Matthew Finkelman, Yoon Kang, and Gerard Kugel

**OBJECTIVE:** Investigate staining potential on composites from short and long-term exposure to green tea, coffee, red wine, and water.

**METHODS:** The study used 144 disc-shaped specimens, measuring 8x2 mm, prepared using four groups of composites (N=36): group 1: Bioactive Flowable Composite with MCP (Pulpdent); group 2: Filtek™ Supreme Ultra (3M); group 3: Fuji II LC® (GC America); and group 4: Beautifil II® (Shofu). Materials were prepared and cured (DEMI™, Kerr) according to manufacturer’s instructions. All samples were wet-ground polished (EcoMet™250, Buehler) sequentially from coarse to smooth grit with final polishing done at 600 grit. Baseline color coordinates (L* a* b*) were then obtained and recorded using an Olympus Crystaleye Spectrophotometer. Samples from each group were submerged in each liquid for three weeks (N=9 per liquid). Color coordinates were taken after submersion for one day, one week, and three weeks. Changes in color (ΔE*) after each period were calculated using the baseline value as a reference.

**RESULTS:** ΔE* tended to increase with length of submersion. There were statistically significant differences between groups, which depended on the beverage and length of submersion (see Tables 1–3). Results showed almost no significant differences in staining amongst the four groups after submersion in water over each period.

**Table 1: One Day Submersion**

<table>
<thead>
<tr>
<th></th>
<th>Water</th>
<th>Green Tea</th>
<th>Coffee</th>
<th>Red Wine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1 ΔE* (SD)</td>
<td>2.46±(2.35)</td>
<td>4.11±(0.51)</td>
<td>15.81±(8.52)</td>
<td>15.07±(3.36)</td>
</tr>
<tr>
<td>Group 2 ΔE* (SD)</td>
<td>3.17±(1.86)</td>
<td>3.03±(1.10)</td>
<td>12.95±(6.19)</td>
<td>23.12±(3.77)</td>
</tr>
<tr>
<td>Group 3 ΔE* (SD)</td>
<td>3.88±(2.36)</td>
<td>12.25±(2.70)</td>
<td>24.97±(26.47)</td>
<td>26.37±(8.74)</td>
</tr>
<tr>
<td>Group 4 ΔE* (SD)</td>
<td>4.85±(2.22)</td>
<td>7.11±(2.77)</td>
<td>15.69±(3.79)</td>
<td></td>
</tr>
<tr>
<td>P-value</td>
<td>0.049</td>
<td>&lt;0.001</td>
<td>0.003</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

**Table 2: One Week Submersion**

<table>
<thead>
<tr>
<th></th>
<th>Water</th>
<th>Green Tea</th>
<th>Coffee</th>
<th>Red Wine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1 ΔE* (SD)</td>
<td>6.06±(5.56)</td>
<td>4.94±(1.75)</td>
<td>17.50±(3.65)</td>
<td>27.65±(9.45)</td>
</tr>
<tr>
<td>Group 2 ΔE* (SD)</td>
<td>3.80±(2.74)</td>
<td>4.99±(1.92)</td>
<td>22.15±(8.48)</td>
<td>29.94±(4.58)</td>
</tr>
<tr>
<td>Group 3 ΔE* (SD)</td>
<td>3.71±(2.27)</td>
<td>19.76±(4.56)</td>
<td>19.36±(4.19)</td>
<td>40.77±(12.19)</td>
</tr>
<tr>
<td>Group 4 ΔE* (SD)</td>
<td>8.61±(5.44)</td>
<td>4.86±(1.88)</td>
<td>12.21±(3.56)</td>
<td>20.55±(2.54)</td>
</tr>
<tr>
<td>P-value</td>
<td>0.071</td>
<td>&lt;0.001</td>
<td>0.004</td>
<td>0.001</td>
</tr>
</tbody>
</table>
Table 3: Three Week Submersion

<table>
<thead>
<tr>
<th></th>
<th>Water</th>
<th>Green Tea</th>
<th>Coffee</th>
<th>Red Wine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1 ΔE* (SD)</td>
<td>8.12ab (5.70)</td>
<td>9.02a (2.69)</td>
<td>24.17a (7.46)</td>
<td>36.59a (11.61)</td>
</tr>
<tr>
<td>Group 2 ΔE* (SD)</td>
<td>3.36a (3.32)</td>
<td>10.61a (4.00)</td>
<td>25.43a (5.32)</td>
<td>28.02a (6.15)</td>
</tr>
<tr>
<td>Group 3 ΔE* (SD)</td>
<td>4.54ab (1.59)</td>
<td>25.29b (2.72)</td>
<td>28.48a (5.12)</td>
<td>43.36a (12.32)</td>
</tr>
<tr>
<td>Group 4 ΔE* (SD)</td>
<td>7.15b (2.42)</td>
<td>14.83ab (4.84)</td>
<td>21.49a (9.10)</td>
<td>29.79a (6.66)</td>
</tr>
<tr>
<td>P-value</td>
<td>0.021</td>
<td>&lt;0.001</td>
<td>0.199</td>
<td>0.028</td>
</tr>
</tbody>
</table>

*Data are presented as mean (standard deviation). For each column, groups displaying a common letter do not exhibit a statistically significant difference.

CONCLUSION: All the materials in this study displayed clinically unacceptable color changes at all times in red wine (ΔE*>8). Group 3 underwent the most color change after three weeks of submersion over time.

*Sponsored in part by Pulpdent Corporation.*
Assessing Staining of Gingival Composites via Color and Surface Texture
Alisha Anand,* Yoon Kang, Sarah Pagni, Jeffrey Daddona, and Britta Magnuson

OBJECTIVES: To determine if polished or unpolished gingival shade composites are susceptible to extrinsic staining by common beverages.

METHODS: In the study, 250 discs were made, 50 for each of the five shades available in Beautiful II Pink (Shofu) (Table 1). Specimens were weighed in predetermined amounts, rolled into a ball, and placed into mold (height=2 mm, diameter=8 mm); weights were used to spread the specimen. Each was light-cured according to manufacturer’s instruction. The discs were stored in distilled water for 24 hours. Half were polished (125 discs) with a grit of 320 and the other half with a grit of 600. Afterwards, discs were equally divided and stored in five beverages (Table 1). Discs were stored for seven days in each liquid. They were then measured with a spectrophotometer. Differences in color outcomes for each staining method between product shades and surface treatment were analyzed with two-way ANOVA and Tukey’s HSD.

Table 1: Beverages and Restorative Shades

<table>
<thead>
<tr>
<th>Group #</th>
<th>Beverage</th>
<th>Shades</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Coffee (Dunkin’ Donuts®)</td>
<td>Light Pink</td>
</tr>
<tr>
<td>2</td>
<td>Tea—English Breakfast (Twinings®)</td>
<td>Dark Pink</td>
</tr>
<tr>
<td>3</td>
<td>Dark Soda (Coca-Cola®)</td>
<td>Orange</td>
</tr>
<tr>
<td>4</td>
<td>Red Wine (Apothic Red)</td>
<td>Violet</td>
</tr>
<tr>
<td>5</td>
<td>Distilled water (control)</td>
<td>Brown</td>
</tr>
</tbody>
</table>

RESULTS: For groups 1, 2, and 3, there was not a statistically significant difference in mean ΔE for any of the colors tested or between textures. For group 4, there was a statistically significant difference in ΔE between orange and violet (p=0.03) and between violet and brown (p=0.03). For group 5, there was a statistically significant difference in ΔE between colors orange and violet (p=0.03).

CONCLUSIONS: This pilot study compared ΔE changes between colors and textures. In group 4, both textures and colors showed a difference. Group 5 only showed changes in color. This pilot study shows that some beverages could impact staining of certain shades. Texture may have an impact dependent on the shade and beverage. This data may be used to calculate the full sample size for a fully powered study.
Oral Health Related Quality of Life in Sjögren’s Syndrome Patients
Kelly Barbera,* Tamar Roomian, and Athena Papas

OBJECTIVES: The goal of this study is to determine the oral health related quality of life (OHRQoL) in patients with Sjögren's syndrome (SS), either primary or secondary, using a questionnaire. This study aims to determine what aspects of life are affected by the autoimmune disease and to what degree. The objective is to obtain a better understanding of the effect of SS on overall health, oral health, and quality of life. In doing so, the hope is to improve the dental care of SS patients, potentially increasing the availability of preventative and palliative care, and therefore reduce the financial burden of dental care faced by SS patients.

METHODS: A questionnaire was created using the OHIP-14 questionnaire and questions from the Harrison Interactive survey on SS. The questionnaire includes questions regarding limitations, general health, xerostomia, oral pain, and oral discomfort. It inquires about the onset of SS symptoms, the time of diagnosis, the method of diagnosis, and the diagnosis of other autoimmune diseases as well as the use of sialogogues, fluoride treatments, and recent dental work. The questionnaire also contains questions about the patient's demographics, socioeconomic level, education, and income. It contains questions with multiple-choice options, select all that apply options, and numerical answer responses. A link to the questionnaire was posted to the Sjögren's Syndrome Foundation website and Facebook page.

RESULTS: Preliminary analysis of the data included responses from 153 individuals with primary SS and 23 individuals with secondary SS. Of these, 80% responded yes to having a sensation of sand or gravel in the eyes; 66% responded yes to needing liquid to swallow; 85% confirmed that their mouths were dry when eating; 68.4% of respondents find it difficult to swallow; and 82% need to sip water constantly. Likewise, 10% of participants who had implants placed reported that the implants failed; 31% of participants who had root canals reported that the endodontically treated tooth failed; 44% of participants had extractions due to decay, while 51.7% had fillings within the last 12 months; 36.8% of participants had crowns placed in the last 12 months; and 61.3% of participants responded that occasionally or more, life in general felt less satisfying because of problems with their teeth, mouth, or dentures.

CONCLUSIONS: Both primary and secondary SS participants reported that the disease had an effect on their everyday OHRQoL.
Grading Trends at Tufts University School of Dental Medicine (2003–2017)
Stacey Berkowitz,* Tamar Roomian, and Steven Eisen

OBJECTIVES: Grade inflation has been identified in a number of undergraduate and graduate programs nationwide, but grading trends thus far have yet to be studied in any dental doctorate programs. The objective of this project was to determine and measure grade variation at Tufts University School of Dental Medicine (TUSDM) over the past 15 years.

METHODS: IRB status was excluded. This retrospective record review analyzed grading trends at TUSDM from 2003–2017 (N=3,034). Data was deidentified prior to analysis. Cumulative GPAs for graduating students up to 2017, grades for the operative dentistry and gross anatomy courses, and demographic information including gender, race, and age were collected. A simple linear regression was used to assess trends over time. Cumulative GPAs were analyzed in two separate groups, since GPAs were calculated out of 100 through 2012 and on a 4.0 grading scale from 2013 onwards.

RESULTS: A statistically significant association was found between year and gross anatomy course grade (grade=2.87+0.02 (year), p=0.02), and year and operative dentistry grade (grade=2.72+0.02 (year), p=0.02). A statistically significant association was also found between year and cumulative GPA from 2003–2012 (cumulative GPA=83.11+0.32 (year), p=0.001) and from 2013–2017 (cumulative GPA=2.53+0.04 (year), p=0.04). The percentage of women in each class year increased by 0.83 percentage points per year (percentage=40.52+0.83 (year), p =0.01). The percentage of black students in each class year increased by 0.33 percentage points per year (percentage=1.02+0.33 (year), p=0.01). Change in median age over time was not statistically significant. Demographic information was evaluated separately and no correlation was found.

CONCLUSION: Cumulative GPA and grades in two courses have increased over time. Although further research is needed, these results may suggest evidence of grade inflation. Other grading systems may be evaluated as alternative measures for the future.
Bioengineered Tooth Bud Model Functionalized with Decellularized Tooth Bud ECM

Ailen Blagajcevic,*1 Elizabeth Smith,2 Weibo Zhang,1 Ali Khademhosseini,3 and Pamela Yelick1,2

1Department of Orthodontics, Tufts University School of Dental Medicine, Boston; 2Program in Cell Molecular and Developmental Biology, Sackler School of Graduate Biomedical Sciences, Tufts University School of Medicine, Boston; 3Division of Health Science and Technology, Harvard-MIT and Biomaterials Innovations Research Center, Brigham and Women’s Hospital and Harvard Medical School

OBJECTIVES: Our objective is to create bioengineered tooth buds to serve as a biologically based replacement tooth alternative to current dental implants. Gelatin methacrylate (GelMA) hydrogel can be used to encapsulate postnatal dental stem cells (DSC) and support odontogenic differentiation and mineralized tissue formation. Here, to enhance enamel and dentin matrix production, we have functionalized bioengineered GelMA tooth buds with decellularized tooth bud extracellular matrix (dTB ECM). We have previously determined that dTBs retain ECM components known to play important roles in dental cell proliferation, differentiation, and tooth morphogenesis. Upon in vivo implantation, cell-seeded dTB scaffolds formed whole tooth structures. To facilitate use of dTB-ECMs for clinical applications, we introduced lyophilized dTB ECM to our bioengineered GelMA tooth bud model.

METHODS: Bilayered tooth bud constructs were fabricated by encapsulating postnatal DSCs and HUVECs, with or without dTB ECM derived from the enamel organ and pulp organ. All constructs were in vitro cultured in osteogenic media for 1, 7, and 14 days.

RESULTS: Bright field imaging of bioengineered tooth bud constructs revealed that dTB ECM resulted in enhanced DSC clustering and increased HUVEC derived neovasculature formation. H&E staining demonstrated the formation of organized rosette-like structures and polarized cells surrounding tb-ECM particles, indicating DSC organization and differentiation. Immunohistochemical analysis was used to define DSC organization, proliferation, and differentiation.

CONCLUSIONS: We find that dTB ECM powder can be used to enhance DSC differentiation in GelMA tooth bud constructs. These promising results suggest that dTB ECM can be used to enhance DSC proliferation and differentiation, advancing the GelMA tooth bud model towards future clinical applications.

These studies were supported by DoD/AFIRM II Award #W81XWH-14-2-0004 (PCY) and NIH/NIDCR/NIBIB R01 DE016132 (PCY).
Interprofessional Model for Integrating Oral Health into Physician Assistant Training

Kevin Campbell,* Beth Buyea, Zuhair Natto, Jinny Park, and Ellen Patterson

Sustainable improvement in the oral health status of underserved populations will ultimately require that primary care providers receive training to identify and manage common oral health issues. Co-location of primary care training programs with dental schools offers an opportunity for interprofessional collaboration to bring this goal to fruition.

OBJECTIVES: The current study evaluates a novel program that integrated didactic training and interprofessional peer-education, providing physician assistant (PA) students with practical oral health knowledge and skills.

METHODS: Targeted oral health topics were integrated across the first-year didactic PA curriculum. PA students (N=50) attended two clinic sessions paired with DMD candidates to learn physical examination and oral health assessment. An interprofessional simulation exercise also trained PA students to identify early-childhood caries and apply fluoride varnish. Using a pretest-posttest design, changes in oral health knowledge were assessed using validated questions from the Smiles for Life online curriculum. PA students were surveyed about their beliefs and attitudes regarding their role in oral health care, and participating DMD candidates were surveyed regarding their experiences teaching PA students in a dental setting.

RESULTS: Pre- and posttest differences were evaluated using McNemar’s and Wilcoxon signed-rank tests. Significant gains were observed in the knowledge posttests analyzed (p<0.0001). However, poor posttest performance on specific questions indicate that training for certain oral health content topics needs further revision. Dental students’ feedback regarding paired clinic experiences was strongly positive and reflected a desire to have more extensive collaborative training with primary care students in the future.

CONCLUSION: Integration of oral health into primary care training presents an important opportunity to expand oral health care and promote interprofessional collaboration with dental providers; this program represents a viable and replicable model for such integration into PA training programs.

National Commission on Certification of Physician Assistants grant #101561-00001.
In Vitro Characterization of Dental Restorative Silk Composites

Stephen Cronk,1* Chiara Ghezzi,2 David Kaplan,2 and Gerard Kugel1
1Tufts University School of Dental Medicine, Boston; 2Department of Biomedical Engineering, Tufts University, Medford, Massachusetts

OBJECTIVE: Current dental composite materials have great potential for improvement in long-term durability. Traditional Bis-GMA/GEGDMA-based composites suffer from several limitations, mainly due to polymerization shrinkage leading to postoperative sensitivity, microleakage, and caries. Our group has previously demonstrated success in producing silk biomaterials that are biocompatible, set rapidly, and possess robust mechanical properties. We now aim to synthesize and optimize silk composite materials for use in dental restorations.

METHODS: Silk fibroin was isolated from Bombyx mori cocoons and purified. Briefly, cocoons were cut into fragments and boiled to extract fibroin before being dissolved in LiBr solution and dialyzed, resulting in an aqueous silk fibroin solution. The silk fibroin solution was then combined at a range of concentrations (0%, 3.5%, 7%, 15%, 20%) with glass ionomer and RMGI dental cement and restorative materials. To obtain identically-sized samples of each silk-restorative combination, cylindrical molds were prepared (N=8 for each sample group). Samples were packed into molds before curing according to manufacturer instructions. After removal from the molds, samples were tested for compressive strength using an Instron machine. Measurements of stress and compressive strain were obtained for each sample.

RESULTS: At increased silk content, samples underwent greater strain before deforming non-elastically than glass ionomer or RMGI materials. Conventional materials resisted the highest stress. Silk (7%) combined with Ketac glass ionomer cement displayed the highest compressive strength of any silk-restorative sample tested (ANOVA, p<0.05).

CONCLUSION: These results are promising, as the amount of silk fibroin can be used to fine-tune the physical properties of a restorative material to more closely mimic natural dentin and enamel. In the dental setting, improvements to composite materials will have a great impact on the lifespan of composite restorations, reduce clinician time replacing failed restorations, reduce patient cost, and improve treatment outcomes.
Effects of Sports Drinks on Enamel Hardness and Composite Microleakage

Taylor Darmetko,* Mary Keezel,* Tamar Roomian, and Britta Magnuson

OBJECTIVES: To test the effects of sports beverages on enamel surface hardness and composite microleakage.

METHODS: Class II composite restorations were placed on 25 extracted human teeth. The teeth were randomly divided into five groups (N=5 per group). Group 1 was the control group, which tested distilled water. Group 2 tested Vitamin Water; group 3 tested Body Armor; group 4 tested Cellucor; and group 5 tested Advocare. Teeth were stored in distilled water at 4°C in a refrigerator. Twice a day, for 15 minutes, five days a week, teeth were placed in their corresponding beverage. At days 0, 14, and 30, the Vicker's surface hardness of each tooth's enamel was measured using the MicroMet 2104. At one month, all samples were subjected to thermocycling. The teeth were then immersed in 2% methylene blue solution for two hours. Samples were cut longitudinally (IsoMet® 1000), and penetration was observed with a digital microscope (Olympus® SZX16). Surface hardness was analyzed using two-way repeated measures ANOVA.

RESULTS: Regarding surface hardness, all three effects, beverage (p=0.0146), time (p=<0.0001), and interaction dependency (treatment and time) (p=<0.0001) proved statistically significant. The control group did not have a statistically significant (p-value=0.644) change throughout the experiment, while the four intervention groups did see a statistically significant decrease (Table 1).

<table>
<thead>
<tr>
<th>Group</th>
<th>Products</th>
<th>pH</th>
<th>Vickers Hardness Day 0 (mean/SD)</th>
<th>Vickers Hardness Day 14 (mean/SD)</th>
<th>Vickers Hardness Day 30 (mean/SD)</th>
<th>P-value (Day 0 to Day 30)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>Distilled water</td>
<td>6.9</td>
<td>453.4 (±285.1)</td>
<td>284.1 (±84.0)</td>
<td>214.5 (±69.1)</td>
<td>0.0587</td>
</tr>
<tr>
<td>Group 2</td>
<td>Vitamin water</td>
<td>3.1</td>
<td>611.4 (±252.8)</td>
<td>132.1 (±54.6)</td>
<td>153.2 (±88.5)</td>
<td>0.0003</td>
</tr>
<tr>
<td>Group 3</td>
<td>Body Armor</td>
<td>3.7</td>
<td>444.1 (±235.9)</td>
<td>213.9 (±257.9)</td>
<td>231.4 (±232.4)</td>
<td>0.0017</td>
</tr>
<tr>
<td>Group 4</td>
<td>Cellucor</td>
<td>3.5</td>
<td>615.3 (±309.2)</td>
<td>173.2 (±30.9)</td>
<td>132.0 (±36.3)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Group 5</td>
<td>Advocare</td>
<td>2.9</td>
<td>556.5 (±207.7)</td>
<td>130.9 (±39.4)</td>
<td>68.5 (±18.5)</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

Using the Wilcoxon Scores to compare microleakage, the results were not statistically significant (p=0.7045).

CONCLUSIONS: Enamel surface hardness decreased over time in all the intervention groups, with Advocare (which has the lowest pH) showing the largest decrease. Therefore, it is possible that drinking low pH sports drinks could lead to decrease in enamel surface hardness in people drinking these beverages frequently. Microleakage did not show a statistical difference between groups.
Perceptions and Realities for Online Professionalism

Alec Eidelman,* Tamar Roomian, and David Leader

OBJECTIVE: This study aims to evaluate the practice, knowledge, and attitudes with respect to policies and use of social media (aka Web 2.0) of dental faculty, staff, and students at Tufts University School of Dental Medicine (TUSDM).

METHODS: We developed an instrument based upon the current United States Health and Human Services Health Insurance Portability and Accountability Act (HIPAA) frequently asked questions examples and literature pertaining to violations of the act. Eight examples were validated for content validity by TUSDM professionalism policy experts and for face validity by students, faculty, and staff. We surveyed approximately 1,600 students, faculty, and staff via email with a survey posted to www.Qualtrics.com. Access, frequency, platform, and intent of social media use information were collected. We stratified descriptive statistics by position. We analyzed results by chi-squared and Fisher’s exact tests to determine associations.

RESULTS: Demographics for the 307 respondents (response rate=19.2%) included gender (63% female), race (61% white non-Hispanic), and position (55.6% student, 20.5% faculty, 23.8% staff). Students were more likely to use social media for personal use, while faculty were more likely to use social media for both professional and personal use. Results demonstrated significant differences in knowledge regarding violations of professionalism by position. Professionalism/HIPAA training appeared to benefit students, but not faculty or staff. There were no significant differences in knowledge among students stratified by level of education (predoctoral v. postdoctoral v. advanced standing).

CONCLUSION: Nearly all sampled students, faculty, and staff at TUSDM reported using social media. Education is imperative at all levels. However, this study demonstrates that past training may not be effective for faculty and staff. Future efforts should center on development of more effective privacy and professionalism training regarding social media use.
Brand-Matched Effect on Fluoride Release of Restoratives through Bonding Agents

Nancy Epstein,* Zuhair Natto, and Steven Eisen

OBJECTIVES: Dental adhesives are used to increase the bond strength of restorative materials to the underlying substrate. In addition to bond strength, it is important that restorative materials are able to release fluoride in order to inhibit caries progression and help form fluorapatite. The purpose of this study was to determine if using an adhesive and restorative material of the same company provides better fluoride release than combining materials of various companies.

METHODS: Forty samples, 5x2 mm, from four different combinations of materials were prepared (N=10): group 1, ACTIVA™ BioActive Restorative™ (Pulpdent) with DenTASTIC™ UNO™ (Pulpdent); group 2, ACTIVA BioActive Restorative with Excite® F (Ivoclar Vivadent); group 3, Compoglass F (Ivoclar Vivadent) with Excite® F; group 4: Compoglass F with DenTASTIC UNO. Twenty samples were prepared as control groups (N=10): group 5: Fuji IX GP® (GC); group 6, Filtek™ Supreme Universal (3M ESPE). All samples were suspended in 4 mL ultra-pure deionized water and placed into new water every 24 hrs. A fluoride ion analyzer (Thermo Scientific Orion™ Star A214) was pre-calibrated with 1, 2, and 10 ppm buffer solutions prior to measurements and fluoride release was measured on days 1, 5, 10, 15, and 20. Data was analyzed using between-subjects ANOVA with a Bonferroni posthoc test. Comparisons were considered significant at p<0.05.

RESULTS: Group 5 had significantly greater fluoride release than all other groups. There was no significant effect of brand-matching materials on fluoride release over time (Table 1).

Table 1. Mean fluoride release for four variations for brand-matching adhesives and restorative materials and two control groups of a glass ionomer and composite restoratives

<table>
<thead>
<tr>
<th></th>
<th>Day 1</th>
<th>Day 5</th>
<th>Day 10</th>
<th>Day 15</th>
<th>Day 20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>7.007124322</td>
<td>1.732672800</td>
<td>0.618447747</td>
<td>0.667138476</td>
<td>0.036725643</td>
</tr>
<tr>
<td>Group 2</td>
<td>9.770040104</td>
<td>0.472375560</td>
<td>0.266628922</td>
<td>0.157357867</td>
<td>0.209974050</td>
</tr>
<tr>
<td>Group 3</td>
<td>11.70634584</td>
<td>0.856239679</td>
<td>0.397188016</td>
<td>0.403302666</td>
<td>0.156414249</td>
</tr>
<tr>
<td>Group 4</td>
<td>24.17343713</td>
<td>7.154328851</td>
<td>1.355602736</td>
<td>2.788016042</td>
<td>0.487775419</td>
</tr>
<tr>
<td>Group 5</td>
<td>174.5711724</td>
<td>36.84435008</td>
<td>21.99933947</td>
<td>17.10761972</td>
<td>6.712715263</td>
</tr>
<tr>
<td>Group 6</td>
<td>0.327435716</td>
<td>0.198914838</td>
<td>0.187591413</td>
<td>0.160075490</td>
<td>0.262514744</td>
</tr>
</tbody>
</table>

CONCLUSIONS: This study demonstrated that using adhesives and restorative materials of the same company did not lead to increased fluoride release compared to mixing company products. It is important to note that only two companies’ products were used so the results of this study may not be generally applied.
Enamel Surface Changes Observed in Gel and Light Activation Whitening

Anthony Falone,* Jeffrey Daddona, Matthew Finkelman, Aikaterini Papathanasiou, and Gerard Kugel

OBJECTIVES: To detect changes in enamel surface microstructure and chemistry composition of teeth treated with gel only and with gel plus light activation whitening.

METHODS: Thirty-five human extracted mandibular incisors stored in artificial saliva were assigned to one of seven groups (N=5): CON=control (artificial saliva only); BST=40% hydrogen peroxide (Opalescence® Boost PF); C3D=Crest® 3D Whitestrips; C3D+LA=C3D with blue light; ZM=25% hydrogen peroxide (Philips Zoom!© gel); ZM+LA=Zoom! gel plus light activation (Philips Zoom! WhiteSpeed®, high intensity); ZM+LA+ACP=Zoom! gel plus light activation with Relief ACP© gel (Philips). All whitening treatments were completed based on manufacturers’ directions of use. Posttreatment samples were imaged using scanning electron microscopy (SEM) and energy-dispersive X-ray spectroscopy (EDS) to determine structural changes and chemistry composition alterations of enamel surface, respectively. Statistical analysis of EDS data to measure comparisons between groups was performed using Kruskal-Wallis test with median and interquartile ranges reported.

RESULTS: SEM images demonstrated enamel surface alterations in all whitening groups compared to CON. C3D+LA and ZM+LA demonstrated the greatest severity of microstructural changes compared to all groups, while ZM+LA+ACP showed improvement in enamel surface roughness compared to ZM+LA. BST showed increased structural changes over C3D and ZM. EDS analysis measuring eight elements showed no significant chemical compositional changes between whitening treatments and control (p>0.05). Four elements (carbon, oxygen, calcium, and phosphorus) were consistently among the highest percent by weight demonstrated in all treatment groups as well as the control.

CONCLUSIONS: Qualitative degradation of enamel surface is observed in whitening treatments, with the greatest severity found in whitening treatments using a light source. However, it appears remineralization treatment postwhitening can substantially reduce enamel surface degradation. The effects of whitening on surface enamel appear limited to structural integrity with insignificant alterations to chemical composition.

Sponsored in part by Pe-G.
Evaluation of Cementum Permeability and Microleakage with Different Bonding Systems

Jesse Feuerstein,* Tyler Beninati,* Gerard Kugel, Steven Eisen, and Sarah Pagni

OBJECTIVE: This study aimed to evaluate the average microleakage allowed by current adhesive bonding agent systems when applied apically to the cemento-enamel junction.

METHODS: A total of 45 third molars were selected at random for Class II mesialocclusal cavity preparations that extended apical to the cemento-enamel junction. Divided into five groups of nine teeth, each received a unique adhesive bonding agent per manufacturer instructions. The control group did not receive bonding agent; the remaining four groups receiving one of the following bonding systems: Clearfil™ SE Bond (Kuraray Medical, CF); ExciTE® F (Ivoclar-Vivadent, EF); Peak® Universal Bond (Ultradent, PU); and Ace®All-Bond SE® (BISCO, AB). Preparations were filled with Filtek™ Supreme Ultra Universal Restorative (3M) and thermocycled for 10,000 cycles between 5°C and 55°C with a dwell time of one minute. Samples were immersed in 2% methylene blue for 24 hours, embedded in acrylic resin, and sectioned mesiodistally at the midline. Using an optical light microscope (Olympus-SZX16®), microleakage was rated at the tooth-restoration interface following the dye-penetration scale: 0=no penetration; 1=penetration less than one-third; 2=penetration beyond one-third; 3=penetration to axial wall. Dye penetration was measured in micrometers with Buehler OmniMet 9.0 software. The median of the microleakage was compared using Kruskal-Wallis test with Dunn's test and the Bonferroni correction for pair-wise comparisons.

RESULTS: Results show a statistical difference in median microleakage score between Group 1 (control) and group 2 (AB, p=0.002) and between group 1 (control) and group 4 (EF, p=0.03). There is no statistical difference in median microleakage score between any of the other groups tested (control, CF, PU).

CONCLUSION: In conclusion, the statistical median microleakage for control, CF, and PU are statistically equal and show no significant differences amongst their groups. Statistical differences were observed with groups AB and EF when compared to control, CF, and PU. Based on these results, it is recommended AB or EF be used with restorations that extend apically to the cemento-enamel junction.
Analysis of Biomimetic Dental Cell Sheet GelMA Tooth Bud Mineralization

Nelson Monteiro,1 Weibo Zhang,1 Rebecca Fisher,*1 Elizabeth Smith,1 Winnie Costa,2 Ali Khademhosseini,3 and Pamela Yelick1
1Tufts University, Boston; 2Brigham and Women’s Hospital, Harvard Medical School, Boston; 3University of California, Los Angeles, Los Angeles

OBJECTIVES: The ability to create a biomimetic replacement tooth would provide a superior therapy for edentulous patients. Previous studies have demonstrated the successful use of dental epithelial/dental mesenchymal (DE-DM) cell sheets, combined with biomimetic enamel and pulp organ gelatin methacrylate (GelMA) hydrogel layers to form mineralized dental tissues. Here, our goal is to improve upon this 3D tooth bud model, by providing increased DE-DM cell interactions, and by overcoming mixing of layers by using successive photo crosslinking of individual cell seeded layers.

METHODS: First, porcine DE or DM cells at cell densities of 0.114 and 0.228x10^6 cell/cm^2 were seeded onto UpCell thermoresponsive tissue culture plates. Human umbilical vein endothelial cells (HUVECs) at a density of 0.057x10^6/cm^2 were seeded on top of DE and DM cell sheets after 12 days in vitro culture. DE-HUVEC and DM-HUVEC cell sheets were harvested after 14 days. Then, biomimetic tooth buds consisting of stacked porcine DE-HUVEC/DM-HUVEC cell sheets sandwiched between GelMA encapsulated DE-HUVEC and DM-HUVEC (ESM) in a 1:1 ratio were cultured in vitro for seven days, and then in vivo for one, three, and six weeks. GelMA encapsulated DE-DM cell constructs (EM), 5% encapsulated DM cells only (M), DM cell sheets with 5% GelMA encapsulated DM cells (MSM), and acellular 5% GelMA (G) constructs were also examined. In vivo mineralization was assessed by micro CT (Bruker), and paraffin embedded and sectioned specimens were examined by H&E staining, polarized light (Pol) and bright field microscopy, immunofluorescent (IF) and immunohistochemical (IHC) analysis.

RESULTS: In vivo implanted ESM, EM, M, and MSM constructs exhibited mineralized tissue formation of specific size and shape and dental cell differentiation marker expression. Higher volumes of more dense mineralized tissue formation was observed in ESM constructs after six weeks, as compared to the other groups. Tukey’s multiple comparison test was employed.

CONCLUSION: Our biomimetic DE-DM cell sheets tooth bud constructs serve as models to optimize the study of DE-DM cell interactions that result in the formation of biomimetic replacement teeth.

These studies were supported by: NIH/NIDCR.NIBIB R01 DE016132 (PCY) R01 DE026731 (PCY).
Faculty Development Initiatives in the Academic Environment: A Systematic Review

Chelsea Johnston, Joyce Ganas,* Natalie Jeong, Amanda Nevius, Leticia Tameirao, and Irina Dragan

OBJECTIVE: This systematic review used the Kirkpatrick model to assess the educational outcomes of faculty development initiatives reported in the dental academic setting.

METHODS: Following an approved protocol respecting the PRISMA guidelines, qualitative and quantitative studies in the English language were selected for inclusion. The current systematic review queried three different databases from 1976 to November 2016. The MeSH terms included were: “staff development,” “faculty, dental,” and “organization and administration.” Two reviewers (ID, CJ) independently examined the acquired articles. The study screening was done in multiple stages: by title, by abstract, and then by full text review. A third reviewer (JG) used the Kirkpatrick assessment model to frame the different outcomes (learner reaction, acquisition of learning, behavioral change, and changes in organizational practice) presented in the full text. Cohen’s κ coefficient was used to calculate the agreement between the examiners. Counts and percentages were calculated for the demographics.

RESULTS: In the study, 257 titles were obtained and the reviewers agreed (kappa 0.74) to include 102 articles for abstract screening, and 70 for full-text review. The articles were published in the USA (79%), followed by Canada (6%), UK (6%). The highest number of articles were from University of Texas Health Science Center at San Antonio Dental School (N=9), followed by New York University College of Dentistry (N=6) and University of Florida College of Dentistry (N=5). All the educational outcomes were reported; the most common were: level 1, reaction (participants’ satisfaction; N=10); and level 3, behavior (self-reported changes in teaching; N=10). Two articles reported on level 4c, patient benefits of faculty development programs.

CONCLUSION: Our review indicates that there is a high interest in the impact of faculty development initiatives. However, the majority of the articles had multiple aims, with a focus on an individual’s professional development rather than the team.
Predoctoral Student Presentations

**Optimal Bonding Properties of Assure PLUS® on Lithium Disilicate**

*Timothy Reichheld, Gregory Monfette, Brian Ganley,* Ritika Kailey, Ronald Perry, Matthew Finkelman, and Gerard Kugel*

**OBJECTIVES:** The purpose of this study was to assess which orthodontic adhesive in combination with the orthodontic bonding resin Assure PLUS® (Reliance Orthodontic Products, Inc.) gives the maximum bond strength of brackets to lithium disilicate.

**METHODS:** Lithium disilicate rods (IPS e.max® CAD) (Ivoclar Vivadent) 1 × 1 × 2 cm were created to represent porcelain crowns. The surfaces of the rods were sandblasted using 50 micron particle size alumina oxide, washed with water, and air dried. One coat of Porcelain Conditioner (Reliance Orthodontic Products, Inc.), was applied with a brush and dried. Assure PLUS was then applied to the porcelain and lightly air dried, followed by one of four different adhesives. There were 72 samples (N=18): 1) Light Bond™ (Reliance Orthodontic Products, Inc.); 2) Opal®Bond™ (Ultradent); 3) Heliosit® Orthodontic (Ivoclar Vivadent); and 4) Transbond® XT (3M Unitek). After application of the adhesive, a standard edgewise universal premolar bracket (American Orthodontics) was applied and light cured using a Radii Plus curing light (Southern Dental Industries) for 20 seconds. After 24 hours, the compressive bond strength was measured using a universal testing machine (Instron®5566A, Norwood, Massachusetts) with 1K load cell and 1 mm/min cross-head speed.

**RESULTS:** Group 1 (median=32.20 MPa) (Table 1) was found to have a statistically significant greater bond strength (p=0.002) when compared to group 2 (median=23.54 MPa). Due to lack of normality in the data, the Kruskal-Wallis test was done followed by post-hoc testing using Dunn’s test with Bonferroni Correction to determine significance (Table 2).

<table>
<thead>
<tr>
<th>Group comparison</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 vs. 3</td>
<td>0.060</td>
</tr>
<tr>
<td>2 vs. 4</td>
<td>0.036</td>
</tr>
<tr>
<td>2 vs. 1</td>
<td>0.002</td>
</tr>
<tr>
<td>3 vs. 4</td>
<td>0.830</td>
</tr>
<tr>
<td>3 vs. 1</td>
<td>0.223</td>
</tr>
<tr>
<td>4 vs. 1</td>
<td>0.316</td>
</tr>
</tbody>
</table>

The values of significance in Table 2 were calculated using medians for the data due to lack of normality. Due to Bonferroni correction, values under 0.008 were considered significant.

**CONCLUSION:** Within the framework of this study, group 1 had a significantly greater bond strength to e. max than group 2. Thus this adhesive is recommended as a clinically preferable means of bonding brackets to lithium disilicate crowns using Assure PLUS as the bonding resin. There was no statistical difference between the other groups.
Pairwise Comparison of the Initial Hydrophilicity of Impression Materials

*Sunny Gaudet,* Sangita Murali, Sarah Pagni, and Gerard Kugel

**OBJECTIVES:** To investigate whether two newly developed experimental super-quick set polyether materials (one light and one medium bodied) are more hydrophilic than vinyl polysiloxane (VPS) materials in the unset stage.

**METHODS:** Using pairwise comparisons, eight light-bodied VPS materials were tested against the experimental Super-Quick-Light-Body polyether material (N=5) (Table 1). Seven medium-bodied VPS materials were compared against the experimental Super-Quick-Medium-Body polyether material (N=5) (Table 2). The experimental polyether materials were tested against themselves as controls (N=5). Each pair of samples was created simultaneously by mixing both materials at once and then smearing a 0.2 mm layer of each material across the surface of two separate glass slides. The slides are subsequently placed side by side, creating an interface between the two impression materials; 45 s after the start of mixing of both materials, a 5µl drop of water was placed on the interface of the two materials by a DropShape-Analysis-System (DSA-30, Kruess); 2 s after the drop touched the surface of the impression materials, the horizontal spreading distance of water on both materials was measured. A standard ratio was calculated using the formula: ratio=experimental polyether material water spread distance/VPS material water spread distance (ratio=1, represents equal water spread distance). The one sample t-test was used to compare the log of the ratios to the log of 1.

**RESULTS:** Mean ratios of water spread distance of all material combinations, except for the controls, were statistically significantly different than 1 (p<0.05) (Table 1, Table 2).

**Table 1:** Mean Ratios of Water Spread Distance of Light Bodied Materials

<table>
<thead>
<tr>
<th>VPS Material Compared against the Experimental Super-Quick-Light-Body Polyether Impression Material (3M ESPE, LOT VT-PENG-Abf_G-0006)</th>
<th>Mean Ratio (SD)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aquasil® Ultra LV Fast Set (DENTSPLY Sirona, LOT150316)</td>
<td>4.68 (0.29)</td>
<td>0.000</td>
</tr>
<tr>
<td>Aquasil® Ultra+ LV fast set (DENTSPLY Sirona, LOT150923)</td>
<td>4.57 (0.29)</td>
<td>0.000</td>
</tr>
<tr>
<td>Aquasil® Ultra XLV Fast Set (DENTSPLY Sirona, LOT160711)</td>
<td>4.99 (0.52)</td>
<td>0.000</td>
</tr>
<tr>
<td>Aquasil® Ultra+XLV Fast Set (DENTSPLY Sirona, LOT160727)</td>
<td>5.08 (0.43)</td>
<td>0.000</td>
</tr>
<tr>
<td>Exafast™ NDS Injection (GC America, LOT1606161)</td>
<td>3.32 (0.28)</td>
<td>0.000</td>
</tr>
<tr>
<td>Flexitime® Light Flow (Kulzer, LOTR010033)</td>
<td>3.54 (0.25)</td>
<td>0.000</td>
</tr>
<tr>
<td>Panasil® Initial Contact Light (Kettenbach, LOT1606611)</td>
<td>1.75 (0.48)</td>
<td>0.0126</td>
</tr>
<tr>
<td>Take 1™ Advanced™ Light Body Wash Fast Set (Kerr, LOT16-1006)</td>
<td>4.49 (1.96)</td>
<td>0.009</td>
</tr>
<tr>
<td>Experimental Super-Quick-Light-Body Polyether Impression Material (3M ESPE, LOT VT-PENG-Abf_G-0006)</td>
<td>1.08 (0.24)</td>
<td>0.5929</td>
</tr>
</tbody>
</table>
### Table 2: Mean Ratios of Water Spread Distance of Medium Bodied Materials

<table>
<thead>
<tr>
<th>VPS Material compared against the Experimental Super-Quick-Medium-Body Polyether Impression Material (3M ESPE, LOT VT-PENG-Abf_P-0004)</th>
<th>Mean Ratio (SD)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aquasil® Ultra+ Medium Fast Set (DENTSPLY Sirona, LOT160525)</td>
<td>3.38 (0.59)</td>
<td>0.0001</td>
</tr>
<tr>
<td>Aquasil® Ultra+ Medium Fast Set DECA (DENTSPLY Sirona, LOT160614)</td>
<td>3.72 (0.96)</td>
<td>0.0009</td>
</tr>
<tr>
<td>Aquasil® Ultra Monophase DECA (DENTSPLY Sirona, LOT160831)</td>
<td>3.32 (0.82)</td>
<td>0.0007</td>
</tr>
<tr>
<td>Exafast™ NDS Monophase (GC America, LOT1605171)</td>
<td>3.26 (0.98)</td>
<td>0.0010</td>
</tr>
<tr>
<td>Flexitime® Monophase Dynamix (Kulzer, LOTR010059)</td>
<td>2.32 (0.69)</td>
<td>0.0041</td>
</tr>
<tr>
<td>Honigum Mixstar Mono (DMG America, LOT756205)</td>
<td>1.72 (0.28)</td>
<td>0.0014</td>
</tr>
<tr>
<td>Take 1™ Advanced™ Medium Fast Set (Kerr, LOT6-2133)</td>
<td>2.92 (0.51)</td>
<td>0.0002</td>
</tr>
<tr>
<td>Experimental Super-Quick-Medium-Body Polyether Impression Material (3M ESPE, LOT VT-PENG-Abf_P-0004)</td>
<td>0.86 (0.18)</td>
<td>0.1726</td>
</tr>
</tbody>
</table>

**CONCLUSION:** The experimental Super-Quick-Light-Body polyether impression material is more hydrophilic in the unset stage than the VPS light body impression materials tested (ratios>1, p<0.05). The experimental Super-Quick-Medium-Body polyether impression material is more hydrophilic in the unset stage than the VPS medium body impression materials tested (ratios>1, p<0.05).

*Sponsored in part by 3M Oral Care.*
MicroRNA Modulation of Fibrin Degradation Pathways in iPSC-Derived Fibroblasts

Tracy Gerona,* Olga Kashpur, Avi Smith, Nailia Mukhamedshina, Behzad Gerami-Naini, Aristidis Veves, Marjana Tomic-Canic, and Jonathan Garlick

OBJECTIVE: Diabetic foot ulcers (DFUs) are chronic wounds observed in diabetic patients that can lead to major complications such as limb amputation. Currently, therapies for treating DFUs have been shown to be effective in roughly 50% of cases. To address this unmet medical need, primary DFU-derived and healthy patient fibroblasts were reprogrammed into induced-pluripotent stem cells (iPSCs) then differentiated to fibroblasts. These iPSC-derived fibroblasts may have altered wound-healing phenotypes that could offer future novel therapies for treating DFUs. We hypothesize that differences in wound healing capabilities between iPSC-derived fibroblasts and their parental, DFU-derived fibroblasts may be attributed to fibrin degradation pathways and the microRNAs (miRNA) that regulate them.

METHODS: To investigate links between fibrin degradation and miRNA that may regulate this process, we used microarray assay data to identify differentially expressed miRNA and mRNA associated with fibrin degradation by comparing parental, DFU-derived fibroblasts and iPSC-derived fibroblasts. DIANA toolkit was used to determine possible regulators of differentially expressed genes. RNA was isolated from both 2D cultures and 3D self-assembled tissues of parental and iPSC-derived fibroblasts using a Qiagen kit, and miRNA and mRNA were quantified via qPCR.

RESULTS: We showed that expression of PLAT and PLAU, activators of fibrin degradation enzyme plasmin, increased in iPSC-derived fibroblasts that had higher fibrin degradation levels. Six miRNAs (miR-196a-5p, miR-204-5p, miR-335-5p, miR-432-3p, miR-487a-3p, and miR-487a-5p) were found to be potential PLAT regulators as they were differentially expressed between primary and iPSC-derived fibroblasts. Of these six miRNAs investigated, miR-487a-3p expression increased (p-value=0.0008) in 3D self-assembled tissues when a decrease in PLAT was observed.

CONCLUSIONS: Our data suggest that fibrin degradation may be regulated by miR-487a-3p, which in turn, may regulate PLAT expression. Functional assays are underway to determine if miR-487a-3p contributes to improved wound healing through the modulation of extracellular matrix production or remodeling.
Treating Hyposalivation: Efficacy and Adverse Effects of Pilocarpine vs. Cevimeline

Craig Holliday,* Arwa Farag, Joseph Cimmino, Tamar Roomian, and Athena Papas

OBJECTIVES: Pilocarpine and cevimeline are muscarinic acetylcholine receptor agonists that stimulate salivary gland function. The primary aim of this investigation was to run a head-to-head comparison for the efficacy of pilocarpine and cevimeline in patients with hyposalivation. The secondary aim was to determine the frequency of side-effects related to the use of the two medications.

METHODS: A retrospective chart review of 110 patients was conducted for patients seen at Tufts University School of Dental Medicine Oral Medicine Clinic between January 1990 and March 2017. As part of their standard of care, patients’ demographics and medical history/medication were collected. Stimulated (SS) and unstimulated (US) salivary flow were recorded at the initial visit and at three- and six-month follow-ups. Changes in dosage/frequency, side effects, and drug discontinuation were also reported at follow-ups. Association of treatment and salivary flow was determined using ANOVA adjusting for baseline salivary flow. Association of side-effect and treatment was analyzed using chi-squared test.

RESULTS: The majority of subjects (91%) were females (average age of 61), and 47% had a diagnosis of Sjögren’s syndrome. At three-month follow-ups, the use of cevimeline showed a statistically significant improvement in SS compared to pilocarpine (p=0.0374) but not in the US. At six-month follow-ups, there was no statistically significant difference in SS or US between the two groups (SS, p=0.1173; US, p=0.7269). The responsiveness to cevimeline and pilocarpine did not seem to be dependent on the diagnosis of Sjögren’s. The use of pilocarpine was associated with a higher proportion of side effects compared to cevimeline (p<0.05) with excessive sweating and stomach upset being the most commonly reported. However, the rate of drug discontinuation was similar in the pilocarpine and cevimeline groups (9% and 11%, respectively).

CONCLUSIONS: Although a difference in efficacy was not found between pilocarpine and cevimeline, pilocarpine was associated with more reporting of side effects.
National Survey of U.S. Periodontists: Suturing Materials for Oral Mucosa

Isaac Hong,* Yumi Ogata, and Yong Hur

OBJECTIVES: There is limited information that assesses general consensus on clinical applications of suturing materials for periodontal surgery and oral implantology. The aim of the study was to evaluate the current trend for sutures used in periodontal practices in the United States.

METHODS: A nine-item survey instrument was developed and conducted at Tufts University School of Dental Medicine (TUSDM). A group of periodontal faculty members at TUSDM independently reviewed and selected the nine most commonly used suturing materials and six different categories of periodontal surgeries prior to distribution of the survey.

RESULTS: A total of 526 completed responses were collected with a response rate of 14.5%. For crown lengthening or periodontal regenerative procedures without periodontal pockets, chromic gut (32.6%) and silk sutures (22%) were used predominantly. Similarly, chromic gut (31.3%) and silk sutures (23.8%) were used frequently in flap surgery with osseous recontouring or other respective procedures. In free gingival grafting procedures, chromic gut (35.3%) and Vicryl, Dexon, and Resolute (25.5%) were preferred. Likewise, chromic gut (31.8%) and Vicryl, Dexon, and Resolute (27.6%) were predominantly chosen for subepithelial connective tissue (CT) grafting. Meanwhile, synthetic absorbable sutures were the choice of materials for regenerative and implant surgeries. For example, in guided tissue regeneration (GTR), Vicryl, Dexon, Resolute (29.9%) and d-PTFE, e-PTFE (34.3%) were favored. For implant therapy without guided bone regeneration (GBR), Vicryl, Dexon, Resolute (28.9%) and chromic gut (29.1%) were commonly used. With GBR procedures or maxillary sinus augmentation, Vicryl, Dexon, Resolute (33.9%) and d-PTFE, e-PTFE (26.4%) were predominantly selected.

CONCLUSIONS: To our best knowledge, this is the first study that assessed the current trend of suturing materials used by periodontists in the United States. We recommend dental surgeons to refer to this information for proper selection of suture materials for various periodontal surgeries.
Does Disinfecting Extracted Teeth with NaClO Affect Shear Bond Strength?

Syed Hussain,* Jeffrey Daddona, Matthew Finkelman, Gerard Kugel, and Steven Eisen

OBJECTIVE: To evaluate the effects of 10% NaClO on dentin and enamel bond strengths using extracted human teeth.

METHODS: In the study, 75 extracted de-identified human teeth were collected, cleaned, and randomly divided into five groups (N=15 per group). Each testing group of teeth was kept in 10% NaClO for a certain duration: zero days (control group), one week, one month, two months, and approximately one year. All teeth were then embedded in orthodontic resin, and occlusal surface was ground flat to expose the middle-depth enamel and dentin. Specimens were then bonded to Filtek™ Supreme Ultra Universal Restorative (3M ESPE) according to manufacturer’s instructions. Each sample was tested for enamel and dentin shear bond strength (SBS) using a universal testing machine (Instron®5566A, Norwood, Massachusetts) with a 1K load cell and 1 mm/min cross-head speed. Descriptive statistics (means and standard deviations) were computed for each group. Normality of data was assessed via the Kolmogorov-Smirnov test; homogeneity of variances was assessed via Levene’s or Welch’s test. P-values less than 0.05 were considered significant. SPSS Version 24 was used in the analysis.

RESULTS: Means of SBS for enamel ranged from 19.55±7.49 to 28.49±7.85 MPa. For dentin, the means ranged from 16.97±5.21 to 21.30±11.39 MPa. For each of the five groups, enamel SBS was higher than dentin. However, there was no significant difference within enamel groups (p=0.058) and within dentin groups’ SBS (p=0.570).

CONCLUSIONS: The duration of storage in 10% NaClO does not affect shear bond strength. Therefore, for research studies investigating SBS using extracted teeth, it is acceptable to use teeth that have been kept in 10% NaClO for up to 1 year. These results do not conclude whether we can or cannot use extracted teeth stored in 10% NaClO for up to a year in studies investigating variables other than SBS.
Perception of Faculty Members Attending the ADEA Summer Program for Emerging Leaders: A Pilot Qualitative Study

Chelsea Johnston,* Natalie Jeong, Tamar Roomian, Gerard Cedrone, and Irina Dragan

OBJECTIVE: The primary aim of this pilot study was to evaluate what the ADEA Summer Program for Emerging Leaders offered as a faculty development opportunity.

METHODS: This study received ethical approval by the Tufts University Institutional Review Board. A qualitative study design used in-person interviews to evaluate the perception of faculty members at TUSDM regarding this initiative. The population investigated included a convenience sample that attended the ADEA Summer Program for Emerging Leaders supported by the Dean’s Office. A control group that did not attend the program was used for comparison. Five faculty members from each group were randomly selected for key informant interviews conducted by one investigator (CJ). The interview questions were based on previously published studies evaluating the exposure of faculty members to leadership experiences.

RESULTS: Participants in both groups think that faculty development initiatives are important ways to develop nonclinical skills. All attendees in the test group said they would recommend the conference to a colleague and that more training would be beneficial to improve leadership skills. Attendees from the control group recognized that the value of faculty development initiatives are important; however, they also suggested that they will only be useful to those who are already motivated to learn leadership skills.

CONCLUSION: Faculty development initiatives are valuable tools to further develop clinicians into successful educators. Based on this study, the ADEA’s Summer Program for Emerging Leaders was useful for improving leadership skills. Further research should be done on both the ADEA Summer Program for Emerging Leaders and other faculty development initiatives to track outcomes.
Interprofessional Education and Collaborative Practice: Perspectives of Students, Residents, and Fellows

Meghan Kelley,* Sarah Pagni, and Irina Dragan

OBJECTIVE: This cross-sectional study focused on how members of American Dental Education Association (ADEA) Council of Students, Residents, and Fellows (CoSRF) perceive the integration of inter-professional education (IPE) and collaborative practice (CP) in a dental curriculum.

METHODS: After ethical approval was obtained, a survey instrument was validated for validity (content and face) and reliability. Content validity was tested by faculty members with extensive knowledge of dental academics and curriculum development by rating each question using a five-point Likert scale. Face validity was tested by students who are not active participants in CoSRF offering their opinions to ensure survey questions were easily understood, useful, and necessary. After the validation process was completed, the survey instrument was distributed to all members of ADEA CoSRF using the Qualtrics platform. The instrument combined qualitative and quantitative data. It queried the definition and use of IPE in a dental education curriculum that members have experienced or wish to experience and their feedback regarding each one. Descriptive statistics (counts and percentages) were reported.

RESULTS: Data suggests that most survey participants (95.65%) feel IPE/CP helps to provide better patient-centered care. Of those participants, 92.86% feel they are able to implement IPE/CP as a dental care provider. However, when asked if IPE/CP is of utmost in a dental curriculum, varying responses were obtained as 24% of CoSRF members answered strongly agree, 28% agree, 24% neither agree nor disagree, 24% disagree. Most survey participants stated they had a formal teaching method of IPE/CP at their respective institutions (72.73%) and feel that IPE is best integrated into a curriculum across all courses and clinics (72.73%) through specific workshops and exercises (27.27%).

CONCLUSION: Within the limitations of the current exploratory study, this population provided a unique and creative framework for the incorporation of IPE and CP into a dental curriculum. Insight derived from this study can be applied to further investigate what students feel are the most successful ways to implement IPE and CP into a dental curriculum.
Overview of the Advanced Standing (International) DMD Programs in the United States

Anne Khalil,* Sadaf Foroutanjazi, Ronald Perry, Irina Dragan, Sarah Pagni, and Driss Zoukhri

OBJECTIVES: There are a wide range of admission requirements for advanced standing programs for internationally-trained dentists among U.S. dental schools. This study aims to review the admission criteria and identify similarities and differences in order to support potential applicants.

METHODS: This cross-sectional study was approved by Tufts University Institutional Review Board. The list of the U.S. dental schools that offer advanced standing programs (ASP), also known as “DMD for international dentists,” was retrieved from the ADEA directory. Data available on the websites of U.S. dental schools that offer ASP were collected by two independent reviewers (SF and ASHK). The variables identified were relevant to the admission requirements: theoretical (national boards) and practical (bench test) exams; test of English proficiency; letters of recommendation; immigration status; and work experience. Basic data information was also collected: program length and class size. Descriptive statistics were performed using SPSS (version 24).

RESULTS: There are a total of 31 U.S. academic institutions that offer ASP. The mean program length is 26.30 months (SD=2.54). The class size has a mean of 27 students (SD=21.22). The degree offered is consistent with the dental school program. Further, 64.52% of the institutions award DDS degree and 35.48% award a DMD degree after graduation. The majority (61.29%) of the schools require only NBDE part 1 and 38.71% require both NBDE part 1 and part 2; 73.33% request a bench test as part of their admission process. A majority (78.57%) of the academic institutions require three letters of recommendation supporting the application.

CONCLUSION: There is a variety in the admission process of the U.S. academic institutions for ASP. The admission process is complex and entails theoretical and practical exams. Further educational research studies are recommended to investigate the topic and assess the validity and reliability of the admission process.
Investigating Health Insurance Trends of Dental Patients Admitted to Hospital (Nationwide Data Analysis)

Zarmina Khan,* Nauman Siddiqui, Moiz Khan, Sarah Pagni, and Ronald Perry

INTRODUCTION: Dental insurance plays an important role in accessing dental care. Individuals who possess dental insurance are more likely to get dental care compared to uninsured. In hospital, dental care significantly contributes to the healthcare burden in United States. Our aim is to investigate the trends of racial disparities in health insurance of dental and oral disease patients admitted to hospital in the United States.

METHODS: We performed analysis of the national inpatient sample (NIS) from 2011 to 2014, which is a part of the healthcare utilization project. We used ICD-9-CM codes (520.XX–529.XX) to identify primary admissions for all oral and dental diseases. We used SAS 9.4 for statistical analysis, frequency was computed using SurveyFREQ as NIS is a stratified sample, and TRENDWT (discharge-level weight) was used for national estimates. Chi-squared test was used for categorical variables. Values that were 10 or less were not reported as per user agreement with HCUP.

RESULTS: From 2011 to 2014, there were 177,645 admissions primarily for dental and oral disorders, of which 53.2% were females and 46.8% were males. The overall mean age was 43.1 years. White people accounted for 64.5% of admissions, followed by African Americans (15.8%) and Hispanics (12.4%). For all admissions, private insurance (37%) was the most common type of insurance follow by Medicare (26.4%) and Medicaid (21%). Asians (53.4%) followed by Caucasians (41%) had the most private insurance, while African Americans had the least private insurance. Caucasians (30.4%) and African Americans (23.8%) were highest uses of Medicare; while Hispanic (36.4%) and African Americans (31.9%) were insured on Medicaid. Oral soft tissue diseases, diseases of the pulp, diseases of the salivary gland, and dentofacial anomalies accounted for about 85% of hospital admissions. There were considerable differences of insurance utilization among all races for various diagnosis.

CONCLUSION: There is a significant difference of healthcare insurance among different racial ethnicities who are hospitalized for dental care in United States.
Factors Affecting the Need for Bone Augmentation following Posterior Extraction

Alicia Kim,* Matthew Finkelman, David Chang, and Archana Viswanath

OBJECTIVES: Numerous studies focus on alveolar preservation and techniques, but few examine the factors affecting the need for bone augmentation. This study sought to identify these factors and determine the success of the procedure, defined as extraction socket(s) having enough support for an implant.

METHODS: We reviewed the charts of 160 adult patients from January 1, 2012, to January 1, 2017. The study group consisted of patients who underwent bone augmentation following posterior tooth extraction, and the control group consisted of patients who underwent posterior extraction without bone augmentation. Age at the time of posterior extraction, gender, periodontal disease, diabetes status, and documented bruxism were the factors included in the analysis. Exclusion criteria included smoking history, osteoporosis/bone disease, cancer treatment, and third-molar extractions. Chi-squared, Fisher’s exact, Hosmer-Lemeshow, and simple and multivariable logistic regression tests were performed on collected data. A p-value<0.05 was considered statistically significant.

RESULTS: Of those reviewed, 52 of 160 patients had sufficient information to be included in the final data set (Figure 1). There was an equal distribution of both genders and the mean age was 61.2±11.7 years at the time of posterior extraction. Primary diagnoses were gingivitis (55.8%) and chronic periodontitis (44.2%). Comorbid conditions included Type II diabetes (13.5%) and bruxism (13.5%). Of the study group, 89.7% patients had successful bone augmentation. Chances of receiving bone augmentation increased slightly with age; despite a p-value>0.05, the beta-value was >0, indicating a trend. Periodontal disease was the only statistically significant factor affecting the need for bone augmentation (Tables 1, 2).
Figure 1: Flow diagram of patient chart review

Table 1: Statistical Significance of Factors

<table>
<thead>
<tr>
<th>Factor</th>
<th>P-value</th>
</tr>
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<tbody>
<tr>
<td>Periodontal disease</td>
<td>0.036</td>
</tr>
<tr>
<td>Diabetes status</td>
<td>0.228</td>
</tr>
<tr>
<td>Documented bruxism</td>
<td>0.092</td>
</tr>
<tr>
<td>Gender</td>
<td>0.468</td>
</tr>
<tr>
<td>Age</td>
<td>0.120</td>
</tr>
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</table>

Table 1: Statistical Significance of Periodontal Disease

<table>
<thead>
<tr>
<th>Periodontal disease</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjusted for gender and age</td>
<td>0.040</td>
</tr>
<tr>
<td>Adjusted for diabetes and bruxism</td>
<td>0.024</td>
</tr>
<tr>
<td>Adjusted for diabetes and age</td>
<td>0.030</td>
</tr>
</tbody>
</table>

CONCLUSIONS: The results indicated that periodontal disease is a significant factor affecting the need for bone augmentation following posterior extraction. A continuation of this study could help confirm the significance, or lack thereof, of the other factors reviewed.
Storage Temperature Effect on Fluoride Varnishes: Bioavailable Fluoride and Viscosity

Grace Kim,* Sarah Pagni, John Morgan, and Gerard Kugel

OBJECTIVE: Dental materials may be affected by extreme climate conditions in resource-limited countries. The aim of this study was to assess the effect of temperature on viscosity and bioavailability of fluoride in fluoride varnish preparations.

METHOD: To measure viscosity and fluoride concentrations, each test had twenty samples where five samples were from each brand of fluoride products (N=5): group A, Aclean® 5% Sodium Fluoride Varnish (Young Dental Manufacturing™); group B, Vanish™ 5% Sodium Fluoride (3M ESPE); group C, VarnishAmerica™ (Medical Products Laboratories™); and group D, Enamelast® 5% Sodium Fluoride Varnish (Ultradent). Samples were incubated at 21°C, 24°C, 40°C, and 52°C for five days. Viscosity was measured by allowing 0.3 mL of varnish to flow on a 45-degree inclined plane. Velocity was calculated after 30 seconds by measuring the distance each material traveled. Fluoride concentrations were measured using Fluoride Ion Selective Electrode (ISE) by Thermo Scientific. Statistical analysis was performed using the Kruskal-Wallis test and Dunn’s test with Bonferroni correction to adjust p-values.

RESULT: Statistical significances were measured in increased viscosity from the storage temperatures 21°C to 52°C in groups A, C, and D (p=0.0019, 0.0225, and 0.0003 respectively) (Table 1). Group A stored at 52°C became too viscous to be removed from the packaging and was deemed clinically unsuitable. Statistical significances were measured in decreased bioavailable fluoride when comparing storage temperatures of 52°C to lower temperatures in groups A, B, and C (p=0.0360, 0.0192, and 0.0013 respectively). Varnishes except for group B experienced packaging leakage at 52°C.

Table 1: Mean Values of Velocity and Fluoride Concentration

<table>
<thead>
<tr>
<th></th>
<th>21°C</th>
<th>24°C</th>
<th>40°C</th>
<th>52°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Velocity (mm/sec)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group A</td>
<td>2.27</td>
<td>2.22</td>
<td>0.80</td>
<td>0.00</td>
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<tr>
<td>Group B</td>
<td>1.13</td>
<td>1.30</td>
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<td>1.11</td>
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<tr>
<td>Group C</td>
<td>1.07</td>
<td>1.22</td>
<td>0.71</td>
<td>0.35</td>
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<tr>
<td>Group D</td>
<td>0.61</td>
<td>1.37</td>
<td>1.92</td>
<td>2.71</td>
</tr>
<tr>
<td>Concentration (ppm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group A</td>
<td>37.44</td>
<td>38.62</td>
<td>35.44</td>
<td>16.72</td>
</tr>
<tr>
<td>Group B</td>
<td>30.16</td>
<td>31.66</td>
<td>57.88</td>
<td>27.80</td>
</tr>
<tr>
<td>Group C</td>
<td>69.64</td>
<td>43.20</td>
<td>57.94</td>
<td>22.82</td>
</tr>
<tr>
<td>Group D</td>
<td>24.34</td>
<td>19.96</td>
<td>38.64</td>
<td>25.86</td>
</tr>
</tbody>
</table>

CONCLUSION: Varnishes stored at 52°C had increased viscosity and decreased bioavailable fluoride. Group B demonstrated favorable characteristics due to the lack of package failures and retained flow. For all brands, a decrease in bioavailable fluoride at 52°C compared to lower temperatures was observed. Further testing is required to determine clinical significance of decreased bioavailable fluoride.
Radiographic Analysis of Crestal Bone Resorption in Vertical Ridge Augmentation

Shawn Kim,* Yumi Ogata, Sarah Pagni, and Yong Hur

OBJECTIVES: The use of guided bone regeneration (GBR) has been shown to restore the reduced alveolar bone volume. Currently, there is limited research on looking at radiographic changes in bone height following restoration in vertical ridge augmentation. The aim of this retrospective study is to evaluate bone level changes after five years of loading in vertical ridge augmentation in implant placement.

METHODS: Data for this study was collected from the electronic health records (EHRs) of patients who underwent vertical ridge augmentation of alveolar bone from July 1, 2006, to September 1, 2012, at Tufts University School of Dental Medicine. Bone level changes observed in the five-year post loading of implants placed with vertical ridge augmentation and pristine bone were compared. The following patient-related and surgical variables were extracted from the EHRs: age, gender, smoking, history of periodontitis, sites of implant placement, types of implants, number, length and diameter of implants, type of bone graft materials, presence of peri-implantitis, and implant failure. The inclusion criteria for the test group included partial edentulism of the mandible with two or three missing teeth, history of GBR with Seibert Class II, III ridge deformity, and five-year post-operative radiograph following implant placement.

RESULTS: In the study, 224 patients were identified after searching through the EHRs. After exclusion of 62 patients, a total of 162 patients (81 GBR and 81 control) were included in the study. There were 73 males and 89 females. There was not a difference in age or gender between the two groups (p=0.25; p=0.43). Independent samples t-test was performed and there was not a statistically significant difference in mean average bone height between the test and control groups (p=0.20).

CONCLUSIONS: The study showed implants placed with GBR and implants in pristine bone were successful. Radiographic changes in marginal bone loss of the dental implant in regenerated bone were not significantly different from the changes of the implants in the native bone. However, there were patient and site-related factors such as the type of graft materials and location of the implants that affected the long-term outcome of the implants.
Newer Generation Oral Anticoagulants: 
An Unguided Increase in Popularity

Tony Kim,* Bhavik Desai, and Arwa Farag

OBJECTIVES: Despite the recent and steady rise in the prevalence of newer generation oral anticoagulants (NGOA), there is no sufficient protocol or standard of care set for their uses. The primary objective of this study was to determine the prevalence of patients on NGOA at Tufts University School of Dental Medicine (TUSDM). The secondary objective was to investigate the current precautionary measures implemented when treating NGOA patients and postoperative complications associated with their use.

METHODS: TUSDM electronic record database system, axiUm, was retrospectively reviewed and patients on NGOA between 2010 and 2017 were identified. Among this population, charts of patients who underwent invasive dental procedures were further reviewed to investigate the preoperative and intraoperative precautionary measures taken and identify any postoperative complications that may be related to the use of NGOA.

RESULTS: A total of 132 patients were identified as taking NGOA at TUSDM, with their annual number steadily rising from 1 in 2011 to 52 in 2017. Among those, 64 patients underwent invasive dental procedures. Pretreatment medical consults were obtained in all NGOA users undergoing invasive procedures; however, only seven patients were instructed to discontinue their medication. Preoperative laboratory testing was not reported for any patient. Bleeding was controlled in 34 patients with the use of hemostatic agents, and four instances of postoperative complications (two blood clotting, one liver clotting, and one delayed healing events) were reported.

CONCLUSIONS: The recent rise in the use of NGOA among patients receiving dental care warrants further attention and clear guidelines. While providers reported receiving medical consultations prior to dental treatment, there are no consistent patterns to the preoperative laboratory testing, discontinuations of drugs, and usage of perioperative precautionary measures. Expert consensus may be of great importance to develop well-established practice guidelines in this area. Moreover, although the incidence of postoperative complications associated with aggressive dental procedures was low and unlikely related to NGOA, drawing conclusions about drug safety based on this preliminary study is unfeasible. Further investigations with larger sample size and comparison of safety profile of NGOA with warfarin are needed.
The Prevalence of Peri-implant Bone Loss in Smokers and Diabetics

Yannis Koroneos,* Tamar Roomian, and Athena Papas

OBJECTIVES: Implant placement has become an increasingly common procedure over the last decade. However, dental implants are not free from complications in immunocompromised individuals. The purpose of this study was to examine the effect of smoking and diabetes on peri-implantitis, measured by peri-implant bone loss.

METHODS: After obtaining IRB approval, an IT query provided records of implant crowns placed at TUSDM between January 1, 2012, and January 1, 2015, from AxiUm electronic health records. A random sample of 161 subjects was categorized into three groups by health status: healthy, smokers, and diabetics. Peri-implant bone loss was measured radiographically, and age, gender, pocket depth (PD), and presence of bleeding-on-probing (BOP) were collected. Peri-implantitis was defined as radiographic evidence of at least 2 mm of bone loss from the implant shoulder. Generalized estimating equation analysis was used to determine association of health status on peri-implantitis and BOP, and odds ratios (OR) were calculated. A mixed-effects linear model was used to determine the association of health status on PD.

RESULTS: Males accounted for 57.8% of the sample and the mean age of subjects was 64.2 years (SD=10.2). Of 187 total sites measured, 120 met the definition for peri-implantitis. Health status was associated with peri-implantitis (p<0.0001). Mean bone loss for smokers, diabetics, and healthy subjects was 2.6 mm (SE=0.09), 2.3 mm (SE=0.1), and 1.9 mm (SE=0.09) respectively. Diabetics and smokers were more likely to have peri-implantitis than healthy patients (OR=3.3, 95CI=1.5–7.1, and OR=8.8, 95CI=3.7–21.0, respectively). Smokers were more likely to have peri-implantitis than diabetics (OR=2.7, 95CI=1.1–6.7). Health status was not associated with BOP or PD.

CONCLUSIONS: Diabetics and smokers are much more likely to suffer from peri-implantitis, which can lead to late-stage implant failure among other problems. These two groups present unique challenges to the growing dental field of implants, with a need for more aggressive preventative measures.
Is There a Reduction in Facial Swelling When Intraoperative Corticosteroids Are Used?

Mythilee Kugathasan,* Zuhair Natto, and Archana Viswanath

OBJECTIVE: Post-operative swelling and trismus is a common sequela to surgical extraction of impacted third molars. The use of intraoperative steroids to reduce postoperative swelling is a common practice among oral surgeons. However, there is always conflicting opinion about the use of peri-operative steroids. The overall objective of this clinical study was to look at the efficacy of corticosteroid Decadron (Dexamethasone) in reducing postoperative swelling following surgical extraction of impacted third molars.

METHODS: This single site prospective clinical study was conducted in the Department of Oral and Maxillofacial Surgery at Tufts University School of Medicine. All patients for whom a decision had been made to extract impacted third molars under deep sedation or moderate sedation were invited to participate in the study. The study group consisted of patients undergoing deep sedation who received corticosteroids, and the control group consisted of patients undergoing moderate sedation who did not receive corticosteroids. For all patients, an initial 3dMD™ scan was obtained prior to extraction for a baseline measurement of facial morphology, and a second 3dMD™ scan was obtained for evaluation and determination of facial swelling at the 72-hour follow-up visit. This technology is based on photographic stereophotogrammetric technology that involves estimating the 3D coordinates of points on an object determined by measurements made by two or more photographic images placed in different positions. The degree of facial swelling between the two groups at the two time points was compared and analyzed for any statistical significance.

RESULTS: Using the 3dMD Vultus software to compare the facial swelling, the preliminary findings found that compared to the baseline, an average of 3.752 cc difference in volume on the left side of the face and 5.762 cc difference of volume on the right side of the face for those who received corticosteroids after 72 hours. For those who did not receive corticosteroids, an average of 11.142 cc difference on the left side and 8.756 cc difference on the right side was found after 72 hours.

CONCLUSION: Although Decadron is commonly used in third molar surgeries, formal confirmation of its relation with facial inflammation by controlled studies is lacking, so it is not at present considered the current standard of care. The preliminary findings from this study thus far indicate that there may be a statistically significant amount of swelling between those who receive Decadron as a corticosteroid preoperatively and those who do not. By continuing this novel study, we hope to contribute to the utilization of corticosteroids in the standard of care for third molar surgery.
Fibroblast Growth and Senescence Response to the Sonic-Hedgehog Inhibitor Vismodegib

Sunnie Kuna,* Arietta Rigopoulos, Sara Mir, Tatiana Mendez, James Baleja, and Addy Alt-Holland

OBJECTIVE: Development of multiple keratocystic odontogenic tumors (KCOTs) and hundreds of basal cell carcinomas (BCCs) are a few of the hallmark manifestations of basal cell carcinoma nevoid syndrome (BCCNS). As abnormal activation of the sonic hedgehog (SHh) pathway in neoplastic basal cells is the major driver of BCC development, SHh inhibitors, such as Vismodegib, have emerged as effective, systemic BCC treatment modalities. However, appearance of drug-resistant tumors and cancer recurrence in BCCNS patients indicates that additional molecular events underlie BCC development. Since epithelial tumors may not only modify their microenvironment but also be influenced by it, we investigated the response of dermal fibroblasts to Vismodegib.

METHODS: Human fibroblasts were treated with 10 nM, 10 µM, or 100 µM Vismodegib or DMSO for seven days, imaged, and counted. Immunostaining and beta-galactosidase production were used to determine the cellular localization of the SHh transcription factor Gli1 and induction of cell senescence.

RESULTS: While fibroblasts retained their characteristic elongated shape under the different treatments, significant inhibition of cell growth was demonstrated in 100 µM Vismodegib-treated cultures. In control, 10 nM or 10 µM Vismodegib-treated cultures Gli1 was localized to the cell nuclei, and similar level of cell senescence was detected in these cultures. However, whereas under 100 µM Vismodegib conditions Gli1 was restricted to the cell cytoplasm, the inhibition of cell growth was coupled with marked decreased in cell senescence.

CONCLUSION: Although aberrant activation of the SHh pathway in BCC cells can be effectively blocked by Vismodegib, this systemic treatment modality is not limited to these cells only. The growth and senescence of fibroblasts within the tumor microenvironment could also be affected by this inhibitor. These cells, in turn, may influence the growth and fate of neoplastic BCC cells and contribute to drug-resistance and cancer recurrence of BCCs and potentially KCOTs in BCCNS patients.

The study was funded by the Michael J. Rainen Foundation and supported by the Basal Cell Carcinoma Nevus Syndrome Life Support Network.
Irradiance of Various Curing Lights Measured on MARC® Light Collector
Aaron Lalonde,* Gregory Monfette, and Gerard Kugel

OBJECTIVES: Demonstrate collimation of light by measuring irradiance over distance for seven different dental light curing units (LCUs) using a MARC light collector.

METHODS: Seven different dental LCUs were tested (N=3): Radii Xpert (SDI) (RX); SmartLite® Focus® (DENTSPLY) (SF); Elipar™ DeepCure-S (3M) (ED); VALO® Grand (Ultradent) (VG); VALO® Cordless (Ultradent) (VC); Bluephase® Style (Ivoclar) (BS); and Bluephase® G2 (Ivoclar) (BG). Measurements were recorded at 1 mm increments from 0 to 10 mm. A MARC® Light Collector (BlueLight Analytics) was used to measure the LCUs with an integrating sphere and NIST-referenced calibrated spectrometer to accurately and uniformly measure LCU output. Each LCU was carefully positioned to ensure the beam was perpendicular to the surface of the light collector. Each LCU was tested and mean clinical irradiance measured in mW/cm² over 20 seconds curing time using a 4 mm diameter anodized aluminum aperture with 60 ms integration time. Statistical analysis was performed via repeated measures ANOVA with Bonferroni correction in posthoc tests.

RESULTS: The results are shown in Table 1 below. RX demonstrated the smallest intensity decrease over 10 mm. RX showed a significantly greater intensity retention over 10 mm compared to VG, BS, ED, and VC (p≤0.001).

<table>
<thead>
<tr>
<th>LCU</th>
<th>RX</th>
<th>SF</th>
<th>BG</th>
<th>VG</th>
<th>BS</th>
<th>ED</th>
<th>VC</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Decrease</td>
<td>13%</td>
<td>25%</td>
<td>35%</td>
<td>45%</td>
<td>47%</td>
<td>53%</td>
<td>58%</td>
</tr>
</tbody>
</table>

CONCLUSIONS: All LCU demonstrated varying degrees of light collimation, with RX achieving the highest normalized percentage intensity at 10 mm.

Sponsored in part by SDI.
Human Papillomavirus Vaccination Coverage and Its Potential Impact on Oral Squamous Cell Carcinoma in the U.S. Hispanic Population: A Systematic Literature Review

Sang Joon Lee,* Trish Dang,* and Aidee Nieto-Herman

OBJECTIVE: A significant percentage of oral squamous cell carcinoma (OSCC) cases are related to HPV infection, and because OSCC tends to have a poor prognosis, it is important to have an up-to-date assessment about HPV vaccination coverage especially for a vulnerable population. The U.S. Hispanic population faces challenges in the healthcare system that makes them more susceptible to certain health conditions such as cancer. To protect such a susceptible population, a better understanding of the current health status needs to be established. Hence, this literature review was conducted.

METHODS: A literature search of Medline (via PubMed) was performed. The investigators screened titles and abstracts and performed full-text screening of eligible studies and journals.

RESULTS: In the study, 20 articles were reviewed and identified to be included. For adolescents aged 13–17 years, Hispanic females showed 55% HPV vaccination coverage, which placed them at second highest after Asian. Hispanic males showed 43.9%, placing them at the highest coverage among males. Among women aged 19–26 years, Hispanics (35.7%) had lowest coverage compared to other races. For males aged 19–26 years, the vaccination coverage was shown to be less than 10%.

CONCLUSION: Significant differences in the coverage were shown between the two age groups and between the genders. Although the vaccination coverage is substantially lower for the older groups, with higher coverage among the younger population, there is a potential to see a decline in the prevalence of OSCC within the U.S. Hispanic population in the future. It may be feasible to conduct research in the future to evaluate the HPV vaccination coverage and incidence of HPV-related OSCC.

(\textit{photo is of Trish Dang})
**Water Absorption and Solubility of Four Dental Composite Materials**

*Dianne Luu, * Jeffrey Daddona, Zuhair Natto, Duong Tran, Yoon Kang, and Gerard Kugel*

**OBJECTIVE:** To determine the water absorption and solubility of four dental composite materials according to ISO 4049:2009.

**METHODS:** Four dental composite materials (N=11) were used to create 44 sample disks approximately 15 mm in diameter and 1 mm in depth: group 1, Filtek™ Supreme Ultra (3M); group 2, Fuji II LC® (GC America); group 3, Fuji IX GP® (GC America); group 4, Ketac™ Nano (3M). The disks were made according to each manufacturer's specifications. A Demi™ (Kerr) dental curing light was used for light-cured samples. Samples were desiccated at 37°C for 22 hours and ambient temperature overnight. Weight, thickness at four points, and diameter were measured at the start and again after seven days in DI water at 37°C. The samples were then measured over a three-week period until they achieved a constant mass. Water absorption percentage (WAP), water absorption (WA) per µg/mm³, water solubility percentage (WSP), and water solubility (WS) per µg/mm³ were calculated, and analysis was conducted using the one-way ANOVA test and posthoc pairwise comparison using the Bonferroni method (Stata version 15). Results were considered significant if p<0.05.

**RESULTS:** There was a statistically significant difference in the WAP, WA, WSP, and WS between the four materials. In WAP and WA, groups 1 and 3 each showed a significant difference when compared to groups 2 and 4 (p<0.001). For WSP and WS, group 1 showed a significant difference when compared to group 2 (p<0.03).

**Table 1:** One-way analysis of variance of water absorption percentage (WAP), water absorption (WA) per µg/mm³, water solubility percentage (WSP), and water solubility (WS) per µg/mm³

<table>
<thead>
<tr>
<th></th>
<th>WAP</th>
<th>WA (µg/mm³)</th>
<th>WSP</th>
<th>WS (µg/mm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>0.98(1.16)</td>
<td>17.91(21.24)</td>
<td>0.00(0.00)</td>
<td>0.00(0.00)</td>
</tr>
<tr>
<td>Group 2</td>
<td>4.61(0.97)</td>
<td>90.44(17.28)</td>
<td>−1.16(1.10)</td>
<td>−24.12(22.89)</td>
</tr>
<tr>
<td>Group 3</td>
<td>1.98(0.04)</td>
<td>41.45(0.51)</td>
<td>−0.66(0.99)</td>
<td>−14.06(21.09)</td>
</tr>
<tr>
<td>Group 4</td>
<td>5.69(1.16)</td>
<td>100.82(19.63)</td>
<td>0.00(0.00)</td>
<td>−4.73(14.18)</td>
</tr>
</tbody>
</table>

**Mean (SD) Values**

**ANOVA**

<table>
<thead>
<tr>
<th></th>
<th>WAP</th>
<th>WA (µg/mm³)</th>
<th>WSP</th>
<th>WS (µg/mm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>48.1</td>
<td>49.5</td>
<td>5.2</td>
<td>3.5</td>
</tr>
<tr>
<td>p</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>0.005</td>
<td>0.03</td>
</tr>
</tbody>
</table>

**Post-hoc Analyses**

<table>
<thead>
<tr>
<th></th>
<th>WAP</th>
<th>WA (µg/mm³)</th>
<th>WSP</th>
<th>WS (µg/mm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1 vs. 2</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>0.01</td>
<td>0.03</td>
</tr>
<tr>
<td>Group 1 vs. 3</td>
<td>0.2</td>
<td>0.03</td>
<td>0.4</td>
<td>0.54</td>
</tr>
<tr>
<td>Group 1 vs. 4</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Group 2 vs. 3</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>0.9</td>
<td>1.0</td>
</tr>
<tr>
<td>Group 2 vs. 4</td>
<td>0.13</td>
<td>1.0</td>
<td>0.01</td>
<td>0.13</td>
</tr>
<tr>
<td>Group 3 vs. 4</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>0.4</td>
<td>1.0</td>
</tr>
</tbody>
</table>

**CONCLUSIONS:** Material resin and filler composition likely plays a role in water absorption and solubility. Groups 2 and 4 are both classic resin-modified glass ionomers (RGMIs). RGMIs typically absorb more water, as in the case with this study. Further testing is needed.
Shear Bond Strength of Self-Adhesive Resin Cements

Siddarth Mehta,* Jeffrey Daddona, Tamar Roomian, Gerard Kugel, and Ronald Perry

OBJECTIVE: To determine the shear bond strengths (SBS) of self-adhesive resin cements to zirconia according to ISO 29022:2013.

METHODS: Three test groups (N=10) were prepared with the following materials: group 1, SpeedCEM® Plus (Ivoclar Vivadent®); group 2, RelyX™ Unicem 2 (3M); and group 3, Maxcem Elite™ (Kerr™). Zirconia plates were sandblasted with 50 micron particles at 14.5 psi for 1 minute. Tetric EvoCeram® Bulk Fill IVA (Ivoclar Vivadent) composite rods, measuring 2.38 mm × 2.00 mm, were prefabricated and cured (DEMI™, Kerr) according to manufacturers’ instructions. Rods were then sandblasted with 50 micron alumina particles at 1 bar and ultrasonically cleaned prior to use. Cement cartridges were bled onto a mixing pad. Composite rods were dipped into a droplet of cement, placed onto the sandblasted zirconia, and inserted into the Ultradent jig. Steady pressure was applied to displace any excess material. Cements were cured for 20 seconds on each side of the composite rod. Samples were then placed in an incubator at 37°C for 24 hours prior to testing to ensure complete polymerization of the material. The Instron®5566A (Norwood, Massachusetts) was used to test the SBS at 1 mm/minute crosshead speed. A microscope (Olympus-SZX16®) was used at 10X magnification to determine sample failure mode. Differences in SBS were analyzed using one-way ANOVA. Tukey’s HSD was used to adjust for multiple comparisons. Failure modes were analyzed using Fisher’s Exact Test.

RESULTS: One-way ANOVA determined that there was a statistically significant difference between groups (p<0.0001). Group 1 showed statistically significant differences when compared to groups 2 and 3 (Table 1). There was no statistically significant difference between groups 2 and 3 (p=0.9551). Differences in failure modes did not show statistical significance.

Table 1: Shear Bond Strength Test Results

<table>
<thead>
<tr>
<th>Material</th>
<th>Mean (MPa) (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>24.70 (2.73)</td>
</tr>
<tr>
<td>Group 2</td>
<td>16.65a (2.20)</td>
</tr>
<tr>
<td>Group 3</td>
<td>16.98a (2.67)</td>
</tr>
</tbody>
</table>

Means sharing the same superscript are not significantly different from each other (Tukey’s HSD, p<0.0001)

Table 2: Failure Mode Results

<table>
<thead>
<tr>
<th>Failure Mode</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adhesive</td>
<td>4 (40.00)</td>
<td>7 (70.00)</td>
<td>6 (60.00)</td>
<td>0.5307*</td>
</tr>
<tr>
<td>Cohesive</td>
<td>6 (60.00)</td>
<td>3 (30.00)</td>
<td>4 (40.00)</td>
<td></td>
</tr>
</tbody>
</table>

CONCLUSION: Group 1 demonstrated statistically better SBS for permanent cementation to zirconia, which may have clinical implications but further testing is needed.

Sponsored in part by Ivoclar Vivadent®.
Material Flexural Strength Comparison Using Marketed and Experimental Automix Tips

David Michaels,* Duong Tran, Yoon Kang, Jeffrey Daddona, Peng Shi, Katie Dunn, and Gerard Kugel

OBJECTIVE: Compare flexural strength of restorative materials using marketed and experimental automix tips.

METHODS: Marketed and experimental automix tips for 11 restorative materials were compared according to ISO 4049:2009. For each material, two groups of tips (N=3 per group) were prepared with one being marketed and another being experimental automix tips. A total of 66 square prism samples, measuring 2 × 2 × 25 mm, were prepared as follows: materials were dispensed into the mold with a Mylar® strip placed on top; steady pressure was applied using a glass plate displacing excess material; samples were cured (DEMI™, Kerr) in accordance with manufacturer's instructions; samples were placed in 37°C distilled water, following ISO instructions based on material classification, for 15 minutes for Core Paste® XP White (CPWhiteSy), Core Paste® XP Enamel (CPEnamelSy), Geristore® Syringeable Kit (G), Ultra-Bond® Plus (UBP), BLOCK-OUT® (BO), Infinity™ SE (ISE), Infinity™ (I), Core Paste® Syringeable Cartirdge Enamel (CPEnSyCart), and Core Paste® Syringeable Cartridge White (CPWhiteSyCart) and 1 hour for PERFEC Temp®II Cartridge (PTIIC) and Perfectemp10® Cartridge (PT10C); samples were taken out of the mold and wet-ground polished (EcoMet™250, Buehler) sequentially from coarse to smooth grit with final polishing done with 600 grit polishing paper to standardize the dimensions; samples were stored in 37°C distilled water for 24 hours to ensure complete polymerization; flexural strength was measured using a universal testing machine (Instron®5566A Norwood, Massachusetts) with 1K load cell and 1 mm/min cross head speed; comparisons of flexural strength between marketed and experimental tips were conducted using a t-test.

RESULTS: Mean flexural strength ranged from 52 MPa (I) to 122 MPa (CPWhiteSyCart) for marketed tips and ranged from 53 MPa (I) to 118 MPa (CPEnamelSy) for experimental tips. P-values exceeded 0.05 for all t-tests (Table 1).
Table 1: Flexural Strength Comparison Results

<table>
<thead>
<tr>
<th>DenMat Restorative Materials</th>
<th>Marketed Tips MPa (SD)</th>
<th>Experimental Tips MPa (SD)</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPWhiteSy</td>
<td>120 (13)</td>
<td>117 (7)</td>
<td>0.78</td>
</tr>
<tr>
<td>CPEnamelSy</td>
<td>117 (4)</td>
<td>118 (4)</td>
<td>0.86</td>
</tr>
<tr>
<td>G</td>
<td>61 (3)</td>
<td>63 (5)</td>
<td>0.65</td>
</tr>
<tr>
<td>UBP</td>
<td>104 (4)</td>
<td>106 (13)</td>
<td>0.81</td>
</tr>
<tr>
<td>BO</td>
<td>117 (11)</td>
<td>116 (3)</td>
<td>0.91</td>
</tr>
<tr>
<td>ISE</td>
<td>60 (8)</td>
<td>61 (3)</td>
<td>0.85</td>
</tr>
<tr>
<td>I</td>
<td>52 (5)</td>
<td>53 (4)</td>
<td>0.80</td>
</tr>
<tr>
<td>CPEnSyCart</td>
<td>116 (5)</td>
<td>102 (15)</td>
<td>0.20</td>
</tr>
<tr>
<td>CPWhiteSyCart</td>
<td>122 (9)</td>
<td>118 (6)</td>
<td>0.52</td>
</tr>
<tr>
<td>PTIIC</td>
<td>59 (5)</td>
<td>61 (4)</td>
<td>0.60</td>
</tr>
<tr>
<td>PT10C</td>
<td>106 (9)</td>
<td>110 (4)</td>
<td>0.48</td>
</tr>
</tbody>
</table>

CONCLUSIONS: Flexural strengths were not significantly different when using marketed and experimental tips with all materials tested.

*Sponsored in part by DenMat.*
Delineating Epithelial-Stromal Interactions in Basal Cell Carcinoma Development

Sara Mir,* Arietta Rigopoulos, Sunnie Kuna, Tatiana Mendez, James Baleja, and Addy Alt-Holland

OBJECTIVE: Basal cell carcinoma nevus syndrome (BCCNS) is a rare genetic condition that is associated with high susceptibility to the development of multiple basal cell carcinomas (BCC) and keratocystic odontogenic tumors (KCOT). In addition to aberrant activation of the sonic hedgehog (SHh) pathway in neoplastic BCC cells, the tumor microenvironment is also known to be an important contributor to the growth and fate of epithelial tumors. Thus, we investigated the effects that BCC cells and fibroblasts exert on each other in vitro in co-cultures in which direct or indirect interactions between these cells were established.

METHODS: Human BCC cells (ATCC TE 354.T) and dermal fibroblasts were grown for 7–21 days either in individual cell cultures, mixed co-cultures or co-cultures in which BCC cells were separated from fibroblasts by a barrier. Cell morphology, expression of key proteins in the SHh pathway and cytoskeleton networks were analyzed using bright-field and fluorescence microscopy.

RESULTS: Whereas fibroblasts demonstrated spindle-shape morphology, BCC cells exhibited varied sizes with multiple elongated membrane protrusions and formed loose colony-like clusters. SHh and Ptc1 were restricted to the cell plasma membrane, and Gli1 was either localized to the cell nuclei or cytoplasm. In mixed co-cultures, BCC cells and fibroblasts grew tightly intertwined, and, while both cell types demonstrated extensive networks of actin and vimentin fibers, keratin fibers were unique to BCC cells. Importantly, when indirect interactions between BCC cells and fibroblasts were allowed, BCC cells formed multiple tumor sphere-like structures that continued to develop over time.

CONCLUSIONS: Enrichment of the growth environment of BCC cells by fibroblasts in co-cultures allows the formation of meaningful interactions between these cells in vitro. Interrogating the cross-talk between these cells will serve as the foundation for delineating the contribution of dermo/epithelial interactions to the persistent development of BCCs and potentially of KCOTs in BCCNS patients.

The study was funded by the Michael J. Rainen Family Foundation and supported by the Basal Cell Carcinoma Nevus Syndrome Life Support Network.
**Evaluation of Two Amalgam Alternative Restorative Materials**

*Gregory Monfette,* *Aaron Lalonde, Timothy Reichheld, Matthew Finkelman, and Gerard Kugel*

**OBJECTIVES:** This study focuses on comparing dentin shear bond strength (SBS) and compressive strength (CS) of two amalgam alternative self-curing restorative materials: commercially available Cention N (Group 1) (Ivoclar Vivadent) and SDI Experimental Material (Group 2) (SDI Limited).

**METHODS:** For CS testing, stainless steel molds were used to prepare each specimen (2 mm × 2 mm × 2 mm) (N=12 per group). Materials were mixed according to manufacturers’ instructions. Specimens were stored in a high-humidity environment at 37°C. After one hour, the specimens were removed, placed in deionized water, and returned to the 37°C oven for 23 hours. At 24 hours, specimens were tested with a Universal Testing machine (Instron®5566A, Norwood, Massachusetts) with a 1K load cell and 1 mm/min cross-head speed. Same procedure was repeated as above with samples being tested after being stored in high humidity environment for seven days. For SBS testing, 10 extracted human teeth (N=10) were embedded in acrylic with the dentinal surface exposed. A 3.5-mm diameter dentinal surface was used for specimen bonding. Materials were mixed according to manufacturers’ instructions and applied without preconditioning/etching or bonding agent. Specimens were stored in a high-humidity environment at 37°C. After one hour, specimens were immersed in deionized water and returned to the 37°C for 23 hours. At 24 hours, specimens were tested with a universal testing machine with 1K load cell and 1 mm/min cross-head speed.

**RESULTS:** For CS, group 1 did not show a statistically significant difference to group 2 (p=0.269 at 24 hrs and p=0.217 at 7 days). For SBS at 24 hours, group 1 showed a statistically significant difference to group 2 (p=0.001), with group 2 having a higher mean.

**Figure 1:** CS and SBS comparison of Group 1 and 2

<table>
<thead>
<tr>
<th></th>
<th>Group 1 Mean (MPa)</th>
<th>Group 1 SD</th>
<th>Group 2 Mean (MPa)</th>
<th>Group 2 SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS 24 Hour</td>
<td>248.6</td>
<td>31.98</td>
<td>235.5</td>
<td>24.21</td>
</tr>
<tr>
<td>CS 7 Day</td>
<td>236.2</td>
<td>39.19</td>
<td>260.6</td>
<td>23.31</td>
</tr>
<tr>
<td>SBS 24 Hour</td>
<td>1.435</td>
<td>0.271</td>
<td>6.196</td>
<td>3.012</td>
</tr>
</tbody>
</table>

**CONCLUSIONS:** Group 1 has a comparable CS compared at 24 hours and 7 days to group 2. However, group 2 has higher SBS when compared to group 1. Group 2 showed similar results in CS and higher SBS; therefore, it may be acceptable as compared to a commercially available product as an amalgam alternative.

*Sponsored by SDI Limited.*
Fracture Forces of Various CAD/CAM Ceramic Anterior Three-Unit Bridges

Sangita Murali,* Sunny Gaudet, and Gerard Kugel

OBJECTIVES: To test the fracture forces of anterior three-unit bridges made from various ceramic CAD/CAM materials.

METHODS: The investigated materials were Ivoclar Vivadent® IPS e.max® CAD (EM), 3M™ Lava™ Esthetic Fluorescent Full-Contour Zirconia Disc (LE), and 3M Lava Plus High Translucency Zirconia Disc shaded with Lava Plus Dyeing Liquid (LP). Wall thickness of the crowns were 1.2 mm (EM), 0.8 mm (LE), or 0.5 mm (LP) with connector cross-sectional areas of 16 mm² (EM), 12 mm² (LE), or 7 mm² (LP). EM (N=14) bridges were ground using Sirona CEREC® inLab® MC XL. LE (N=15) and LP (N=12) bridges were milled on Sirona inLab®MC X5. All restorations were heat-treated based on the manufacturers’ instructions using an Ivoclar Vivadent Progmat® EP5000G2 furnace for crystallization (EM) or 3M Lava Furnace 200 for final sintering (LE, LP). All restorations were cemented on tooth shaped abutments made from a composite material to simulate dentin. Force was applied to the bridge pontic using an Instron®5566A universal testing machine to determine fracture force. Two sample t-tests (p<0.05) have been performed for all groups.

RESULTS: Mean fracture force was significantly higher for LE (1789N) and LP (1745N) as compared to EM (1458N). There was no statistically significant difference of mean fracture forces between LE and LP.

CONCLUSIONS: Zirconia bridges made from LE and LP with thinner wall thicknesses and lower cross-sectional connector areas compared to EM showed higher fracture forces. Within the confines of this study, zirconia bridges offer higher mechanical properties and therefore allow more tissue-preserving tooth preparation.

Sponsored in part by 3M Oral Care.
**Temporomandibular Joint Disorders Consultation and Follow-Up at Predoctoral Clinic**

*Byung Min Nahm,* *Noshir Mehta, Shuchi Dhadwal, Tamar Roomian, and Archana Viswanath*

**OBJECTIVE:** Comprehensive care at a dental school clinic must screen for temporomandibular joint disorders (TMDs), and it is a student dentist's essential role to seek out appropriate referral for consultation for those with TMD signs and symptoms. In the previous study, “Prevalence of Temporomandibular Joint Disorders at Dental School Predoctoral Clinic,” we found that 556 patients complained of jaw pain. This is a follow-up study to evaluate the outcome of TMD consultation.

**METHODS:** Dental records of patients who reported TMDs signs and symptoms in the five-year time period were reviewed. A specifically designed questionnaire incorporated into a comprehensive exam at predoctoral clinics at Tufts University School of Dental Medicine (TUSDM) was used to select a total of 556 patients with suspected TMDs (N=556). Among those, patients referred for TMD consultation were identified and clinical notes from the consultation were reviewed. Advanced cases referred out to Craniofacial Center at TUSDM due to their complexities were separately evaluated for their initial diagnoses and rendered treatments. The prevalence of referral, diagnosis, and treatment were calculated based on the number of corresponding response (Table 1).

**Table 1:** Referral for diagnosis and treatment of patients with suspected TMDs from record reviews at Tufts University School of Dental Medicine Predoctoral Clinic

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>N</th>
<th>Prevalence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Referral Rate</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Referral (N=326)</td>
<td>194</td>
<td>59.51</td>
</tr>
<tr>
<td>Predoctoral Clinic</td>
<td>37</td>
<td>11.35</td>
</tr>
<tr>
<td>Craniofacial Center</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Diagnosis</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TMDs (N=24)</td>
<td>10</td>
<td>41.67</td>
</tr>
<tr>
<td>Myalgia (N=24)</td>
<td>21</td>
<td>87.50</td>
</tr>
<tr>
<td>Others (N=24)</td>
<td>22</td>
<td>91.67</td>
</tr>
<tr>
<td><strong>Initial Treatment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Occlusal Guard (N=197)</td>
<td>147</td>
<td>74.62</td>
</tr>
<tr>
<td>Muscle Relaxant (N=197)</td>
<td>4</td>
<td>2.03</td>
</tr>
</tbody>
</table>

**RESULTS:** The total number of patients who reported TMD signs and symptoms during the five years was 556. A total of 326 patients received a referral for TMD consultation. Of those, 194 (34.9%) received a consultation at predoctoral clinic and 37 (6.7%) received more advanced consultation at Craniofacial Center.

**CONCLUSIONS:** This record review analysis of 556 patients demonstrates the referral rate of patients with suspected TMDs in predoctoral clinics. Results from this ongoing study indicate that there is a need for educating predoctoral students to identify TMDs and seek appropriate referral with a follow up.
A Survey of Caregivers Regarding Dental Care for Autistic Children

Kaitlyn O’Connell* and David Leader

OBJECTIVE: To determine if children with autism spectrum disorder (ASD) encounter difficulties in accessing proper dental care and to determine the satisfaction of their current dental care from the perspective of their caregivers.

METHODS: The data for the study were obtained through a Qualtrics survey distributed to caregivers involved in autism support services through the Northeast ARC of Massachusetts. The 77 participants were parents or caregivers of a child that was a) diagnosed with autism spectrum disorder (ASD) and b) aged 5–17 years old.

RESULTS: Information about the child such as their ASD specifications (severity level, accompanying impairments) and their dental care (type of insurance, type of office last seen, frequency of dental visits, types of procedures undergone) were collected. Correlations found significance in using Fisher’s exact test (p<0.05) for: severity level and cooperation, severity level and whether the child had ever been referred out, accompanying impairments (intellectual, language, and genetic/medical conditions), and whether the child had ever been referred out due to issues associated with behavior or treatment complexity.

CONCLUSION: Although most caregivers are satisfied with the current dental care of their child, dentists are perceived to be less confident and prepared to treat those children with higher severity ASD or with accompanying impairments. Children with higher severity ASD or with accompanying impairments are also found to be more uncooperative and are more likely to be referred out for specialized care.
Treatment of Severe Odontogenic Infection: Antibiotic Management Preferences of Oral Surgeons

Stanley Ojukwu,* Hannah Leahey, Archana Viswanath, Matthew Finkelman, Eliezer Brecher, and William Gilmore

OBJECTIVES: Severe odontogenic infections (OI) are defined as fascial space infections that require an operatory room for incision and drainage. Appropriate antimicrobial therapy is crucial in the treatment of severe OIs. The primary objective of this research project is to determine prescription practices for the management of severe odontogenic infections among oral surgeons.

METHODS: A multiple choice, self-reported survey of prescription practices was utilized to determine prescription trends among oral surgeons. The questions were previously published in Antibiotic prescription in the treatment of odontogenic infection by health professionals: a factor to consensus in 2012. The demographic questions asked the setting and geographic region in which the clinician practices and the year they graduated from residency program. The survey was distributed to 877 members of the American Association of Oral Maxillofacial Surgery with 64 complete responses.

RESULTS: Penicillin was the preferred first choice antibiotic to treat OIs, selected by 73.4% of respondents, while 18.7% of respondents selected clindamycin as their first choice and 7.8% of respondents selected other antibiotics. Clinicians in a private practice setting were most likely to prescribe penicillin as a first choice, while those in a hospital or academic setting had a more varied prescription pattern. This trend was not statistically significant.

CONCLUSION: The majority of oral surgeons prescribe penicillin as a first choice antibiotic in treating OIs, particularly those in private practice. This could be attributed to the type and complexity of OIs a private practice clinician may encounter versus those working in a hospital or academic setting. These results were not statistically significant and would require a larger sample size for a more conclusive result.
Risk of Radiation-Induced Dysgeusia in Smoking and Nonsmoking Head and Neck Cancer Patients

Da Min Park,* Zachary Quay-de la Vallee, Kathryn Huber, Miriam O’Leary, Tamar Roomian, and Arwa Farag

OBJECTIVE: Smoking is known to have a negative effect on taste perception. In head and neck cancer (HNC) patients, dysgeusia is among the most commonly reported adverse side effects following radiation therapy (XRT), which can diminish patient quality of life and survival. This retrospective study aimed to assess the effect of past and current smoking on the onset and resolution of dysgeusia in patients receiving XRT for treatment of HNC.

METHODS: Electronic health records of adult HNC patients, treated at the Tufts Medical Center between January 1, 2000, and April 1, 2017, were reviewed. Collected data included patient demographics, primary cancer diagnosis (location, stage, and metastasis), XRT (initiation, cumulative dose, and duration), chemotherapy, surgery, smoking status, as well as dates of onset and resolution of dysgeusia. Kaplan-Meier with Log-Rank Test and Cox proportional hazards models were used to analyze the relationship between smoking status and the onset and resolution of dysgeusia.

RESULTS: Among 171 patients, 102 met inclusion criteria, of which 61.8% developed dysgeusia. Mean age at the time of XRT initiation was 58.3 (SD=12.9). Sixty-six percent of the patients were either former or current smokers at the time of initiation of XRT, and 34% were never-smokers. Never-smokers were found to be at higher risk for developing dysgeusia than smokers (hazard ratio 1.75, p=0.0304) and to develop the disease more rapidly after starting XRT (median survival time=24 vs. 44 days, p=0.0256). However, no significant association was found between smoking status and the resolution of dysgeusia (p=0.3923). Combining XRT with chemotherapy and/or surgical tumor resection failed to show significant association with faster onset and/or delayed resolution of dysgeusia (p=0.4755 and 0.8861, and p=0.1371 and 0.2675, respectively).

CONCLUSION: In HNC patients receiving XRT, non-smokers seem more prone to dysgeusia than smokers. This can be explained by the compromised baseline taste perception in the smokers that may eliminate the significance of any further taste deterioration. Thus far, there is no definitive preventive strategy or treatment available for dysgeusia, and further investigations are needed. Results on combining chemotherapy and/or tumor resection with XRT should be interpreted with caution due to the retrospective nature of the study.
Posterior Superior Alveolar Artery Association with Membrane Perforation during Lateral Sinus Augmentation

Nari Park,* Yong Hur, Sarah Pagni, and Yumi Ogata

OBJECTIVE: Accidental severing of maxillary sinus vasculature, particularly the posterior superior alveolar artery (PSAA), is a common intraoperative complication during lateral sinus augmentation. The hemorrhage may impair surgical field visualization, potentially leading to Schneiderian membrane perforation, the most common surgical complication of the procedure. The aims of this retrospective study were: (1) to assess the prevalence, diameter, and location of the PSAA related to lateral sinus augmentation and (2) to investigate possible associations between anatomical variations of the PSAA and membrane perforations.

METHODS: Patients who received lateral sinus augmentation at Tufts University School of Dental Medicine from July 1, 2006, to June 30, 2017, with pre-operative cone-beam computed tomography (CBCT) images were included in this study. The CBCT images were analyzed to evaluate possible associations between prevalence of the PSAA, diameter of the PSAA, location of the PSAA, distance of the PSAA from the alveolar crest, distance of the PSAA from the sinus floor, residual bone height, and Schneiderian membrane perforation. Statistical analysis was performed using the independent samples t-test and Wilcoxon rank-sum test at p<0.05 level.

RESULTS: A total of 204 patients were included in the study. Of these, 64 patients (31.37%) had membrane perforation. The PSAA was prevalent in 62.75% of the sinuses on CBCT images, and the most frequent location of PSAA was intraosseous (57.0%). Variations in anatomical factors of the PSAA and residual bone height were compared between perforation and nonperforation groups (Table 1). There are no statistically significant differences in prevalence of PSAA, diameter of PSAA, distance of PSAA from the alveolar crest, distance of PSAA from the sinus floor, and Schneiderian membrane perforation. Statistical analysis was performed using the independent samples t-test and Wilcoxon rank-sum test at p<0.05 level.

Table 1: Anatomical variations of the PSAA and residual bone height

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Perforation</th>
<th>Nonperforation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean prevalence of PSAA, n(%)</td>
<td>64 (31.37%)</td>
<td>140 (64%)</td>
</tr>
<tr>
<td>Median diameter of PSAA (mm)</td>
<td>1.08±0.38</td>
<td>1.17±0.44</td>
</tr>
<tr>
<td>Mean distance of PSAA from alveolar crest (mm)</td>
<td>13.98±5.75</td>
<td>14.31±4.90</td>
</tr>
<tr>
<td>Mean distance of PSAA from sinus floor (mm)</td>
<td>9.91±5.74</td>
<td>9.68±4.78</td>
</tr>
<tr>
<td>Mean residual bone height (mm)</td>
<td>4.00±1.68</td>
<td>4.55±2.21</td>
</tr>
</tbody>
</table>

CONCLUSION: Pre-operative CBCT provides valuable information for surgical planning of lateral sinus augmentation to reduce the incidence of complications. Within the limitations of this study, there were no significant associations between certain anatomical variations of the PSAA and membrane perforation during lateral sinus augmentation.
Assessing Patient's Oral Health Knowledge Acquisition Using an Oral Health Educational Booklet in a Dental School Setting

Tuvy Phan,* Carole Palmer, Jose Novoa, Moiz Khan, Amanda Elpers, Monica Batra, and Natalie Hagel

OBJECTIVE: A patient education booklet, Oral Health & Disease Prevention, was created to specifically target the patients at the predoctoral clinic at Tufts University School of Dental Medicine (TUSDM). The booklet was introduced into the TUSDM undergraduate clinic to provide patients and students visuals in addition to low literacy information on the prevention of dental disease. The overarching goal of this study was to test the effectiveness of the Oral Health & Disease Prevention booklet as an intervention on patient oral health knowledge.

METHODS: There were two phases to the study. In phase 1, the aim was to test the validity of the pre- and post-survey. One survey was created on Qualtrics based on the content of the booklet and was used as both the pre- and post-assessment. To test for content validity, up to three TUSDM faculty members were given the survey and asked to rate each question individually using a five-point Likert scale. All feedback and comments were reviewed and updates were made to the final survey. In phase 2, up to 20 adult patients who have had no prior exposure to oral hygiene instruction at TUSDM were recruited for the study. A pre-survey was administered to the patient before the use of the booklet at the beginning of a schedule NPE or comprehensive exam appointment. The initial pre-survey, before the use of the booklet, was used to evaluate if the patient would qualify to complete the post-surveys. Out of the 14 survey questions, the patient had to have answered at least two incorrectly in order to qualify to continue in the study. After the patients had qualified, they were exposed to the booklet as an intervention with the student dentist and afterwards were given a post-survey. The same post-survey was given to the patients a second time during their standard of care follow-up appointment.

RESULTS: Four reviewers responded to the questionnaire for content validity of the survey. All four reviewers believed that all of the questions and its content was important to include into the final draft of the survey. The data from phase 2 of the study is currently in the process of being conducted and reviewed.

CONCLUSION: The data collected from the patient pre-survey helped gauge how knowledgeable a patient was on oral health and disease prevention prior to using the patient education booklet as an intervention. After the use of the educational booklet, the patient post-surveys helped indicate how effective this tool was on patient recall and improving patient oral health knowledge. This information will ultimately provide us with a better understanding of what educational strategies and tools can be used to improve patient and provider interaction within the clinic.
Coronectomy of Mandibular Third Molars: A Case Series

David Powers* and Archana Viswanath

OBJECTIVE: Coronectomy or intentional root retention is a procedure where the crown of a tooth is removed but the root is left to avoid damage to the inferior alveolar nerve. There are chances of follicle or follicle remnants to act like a periodontal pocket and become a site of infection. The aim of this study was to evaluate the fate of the root after coronectomy in patients with high risk for inferior alveolar nerve damage as evaluated by the intra oral periapical radiograph.

METHODS: This retrospective study chart review was conducted in the Department of Oral Surgery at Tufts University School of Dental Medicine. A search of the term “coronectomy” was performed with all the electronic health records. Records of completed coronectomy procedures in the past 13 years were compiled. All procedures were done in the oral surgery postdoctoral clinics.

RESULTS: Eleven patients (3 males, 8 females, mean age of 31 years) who received coronectomy to reduce the risk of inferior alveolar nerve injury (IANI) were followed long-term. The treated teeth were horizontally impacted third molars in the mandibular left (N=6) or mandibular right (N=5) areas and were all ankylosed with the surrounding alveolar bone. During the extraction, the bone around the crown was removed to expose the crown, and then the tooth was resected at cement-enamel junction (CEJ). Any secondary trauma to the healthy root was minimized and remained intact after primary suture. The mean follow-up time was 12 months, and all sites showed good bone healing after the crown removal. None of the patients had any inferior alveolar nerve damage, and none of the patients required second surgical removal. Two patients had delayed bone healing (observed at three weeks and two years).

CONCLUSION: Coronectomy is a good alternative in cases where the lower third molar was close to the inferior alveolar nerve to avoid injury. The rate of complications in this study was very low.
Effects of pH on Shear Bond Strength of Bioactive Cement

Meghan Powers,* Sarah Pagni, Jeffrey Daddona, Yoon Kang, and Britta Magnuson

OBJECTIVES: To test the effects of pH levels on shear bond strength (SBS) of bioactive cement and a resin cement to dentin.

METHODS: Extracted human teeth were used for dentin samples and divided into two storage time periods: 24 hours and 1 week (N=30 per group). Within each time period the samples were divided into three storage solutions: artificial saliva pH 7, artificial saliva pH 3, and deionized water (N=15 per group). Before storage, a button of cement bonded to the dentin samples. Cements used were RelyX™ Unicem 2 Self-Adhesive Resin Cement (R=resin) and Ceramir® Crown & Bridge (BA=bioactive). Product was applied following manufacturer’s guidelines. After the designated storage time, teeth were dried and tested. SBS was tested using a universal testing machine (Instron®5566A, Norwood, Massachusetts); crosshead speed moved at 5 mm/min until failure. A two-way ANOVA with check for normalization was done for analysis.

RESULTS: Means, medians, standard deviations (SD), and interquartile ranges (IQRs) for compressive stress at maximum compressive load were calculated (Table 1). For the 24-hour group, there was a statistically significant difference in mean compressive stress at maximum compressive load between group R and BA (p<0.001). There was not a statistically significant difference in compressive stress at maximum compressive load between any of the conditions (p=0.33). For the 1-week storage group, there was a statistically significant difference in mean compressive stress at maximum compressive load between groups R and BA (p=0.002). There was not a statistically significant difference in compressive stress at maximum compressive load between any of the conditions (p=0.06).
### Table 1: Shear Bond Strength Results

<table>
<thead>
<tr>
<th>Variable</th>
<th>Storage Method (37°C)</th>
<th>Shear Bond Strength (MPa)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean (SD)</td>
<td>Median (IQR)</td>
</tr>
<tr>
<td>24 hours (p&lt;0.001)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group R</td>
<td>Deionized Water (control)</td>
<td>11.97 (5.53)</td>
<td>11.12 (7.61)</td>
</tr>
<tr>
<td></td>
<td>Saliva pH 7</td>
<td>12.10 (8.80)</td>
<td>11.24 (10.50)</td>
</tr>
<tr>
<td></td>
<td>Saliva pH 4</td>
<td>12.05 (6.39)</td>
<td>8.34 (10.00)</td>
</tr>
<tr>
<td>Group BA</td>
<td>Deionized Water (control)</td>
<td>6.33 (3.31)</td>
<td>6.33 (5.27)</td>
</tr>
<tr>
<td></td>
<td>Saliva pH 7</td>
<td>0.99 (0.77)</td>
<td>0.10 (0.81)</td>
</tr>
<tr>
<td></td>
<td>Saliva pH 4</td>
<td>0.44 (0.81)</td>
<td>0.11 (0.08)</td>
</tr>
<tr>
<td>1 week (p=0.002)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group R</td>
<td>Deionized Water (control)</td>
<td>5.41 (5.35)</td>
<td>3.42 (8.44)</td>
</tr>
<tr>
<td></td>
<td>Saliva pH 7</td>
<td>9.80 (2.96)</td>
<td>8.87 (2.70)</td>
</tr>
<tr>
<td></td>
<td>Saliva pH 4</td>
<td>10.11 (2.33)</td>
<td>11.27 (3.02)</td>
</tr>
<tr>
<td>Group BA</td>
<td>Deionized Water (control)</td>
<td>3.60 (2.58)</td>
<td>2.47 (1.93)</td>
</tr>
<tr>
<td></td>
<td>Saliva pH 7</td>
<td>2.80 (2.27)</td>
<td>3.72 (4.02)</td>
</tr>
<tr>
<td></td>
<td>Saliva pH 4</td>
<td>6.16 (2.60)</td>
<td>5.68 (1.10)</td>
</tr>
</tbody>
</table>

**CONCLUSIONS:** Across all conditions, group R showed a stronger bonding to dentin in the testing conditions than group BA.
Evaluation of Treatment Outcomes of Obstructive Sleep Apnea Patients Treated with Mandibular Advancement Devices at an Academic Institution

Devon Ptak,* Ruba Alkadhi, Il Ho Tae, Matthew Finkelman, and Leopoldo Correa

OBJECTIVE: The aim of this study is to evaluate the treatment outcomes of OSA patients treated with MADs in the Tufts University School of Dental Medicine (TUSDM) Dental Sleep fellowship program.

METHODS: A convenience sample of 32 OSA patients treated with MADs by one dental sleep medicine fellow over fellowship duration (one year) were reviewed. Seven different MAD designs were used. Patient characteristics were collected at baseline. AHI, ESS, and lowest O₂ saturation were collected pre- and post-treatment. Patients were then stratified into categories based on AHI: normal (<5 events/hr), mild (5–15 events/hr), moderate (15–30 events/hr), and severe (>30 events/hr).

RESULTS: Of the 32 patients, there were 17 females and 15 males. The mean age of the sample was 51.5 years with a mean BMI of 26.5. Of the patients with both pre- and post-measurements for AHI (N=28), the mean AHI, prior to treatment, was 21.78 (SD=17.73). Over the fellowship, these patients showed a mean decrease in AHI of 14.83 (SD=16.04, p<0.001). Furthermore, there was a general decrease in patients’ AHI severity level, with 71.43% (N=20) of patients moving to a less severe classification and 28.57% (N=8) of patients staying at the same level. Prior to treatment, the breakdown of AHI severity was: normal (3.57%, N=1), mild (50.00%, N=14), moderate (21.42%, N=6), and severe (25.00%, N=7). Post treatment, the breakdown was: normal (50.00%, N=14), mild (42.85%, N=12), and moderate (7.14%, N=2). No patients were classified as severe post-treatment. Of the patients with both pre- and post-measurements for ESS (N=26), there was a mean decrease in ESS of 4.40 (SD=4.14, p<0.001). Of the patients with data for both pre- and post-“lowest O₂ saturation level” (N=11), there was a mean increase in lowest O₂ saturation level of 7.45 (SD=8.14, p=0.013).

CONCLUSIONS: Patients treated with MADs over the course of the fellowship showed improvement in their OSA control. This suggests that there is significant utility to incorporating dental sleep medicine training into the curriculum for students and opportunities for improved patient care.
Evaluating Students’ Motivations to Pursue Dental Public Health: Questionnaire

Isaac Hong, Rameez Raja,* Soo-Woo Kim, John Morgan, Tamar Roomian, and Britta Magnuson

OBJECTIVES: Dental public health (DPH) is a dental specialty that focuses on improving oral health of a population. Currently, there is limited literature that assesses U.S. dental students’ motivations to pursue advanced education and eventually a career in DPH. The objective of the study was to identify students’ motivational factors involved in deciding DPH as a future career.

METHODS: A 41-item survey was developed and released online to third- and fourth-year dental students at Tufts University School of Dental Medicine (TUSDM). The survey consisted of 26 questions on a five-point Likert scale and 15 nominal questions. Survey items were pretested for validity and reliability prior to release. The collected data were analyzed using chi-squared test and Mann-Whitney U test.

RESULTS: A total of 46 responses were completed, with an overall response rate of 12.1%. Of those who responded, 37% said that they have an interest in pursuing DPH either as an advanced education or a career. It was found that there were no statistically significant associations between the interest to pursue DPH and demographic factors such as age, year in dental school, gender, and ethnicity. Meanwhile, dental students who expressed interest in DPH showed a statistically significant difference than those not interested in DPH in several categories. Students interested in DPH showed stronger agreement with having an innate desire to serve dentally underserved populations, desire to collaborate with other public health professionals, and invaluable mentorship with advice in the direction of DPH. They also strongly agreed that there is a need for more well-trained DPH professionals in the U.S. and abroad.

CONCLUSIONS: The questionnaire assisted in identifying factors associated with students who are interested in pursuing a career in DPH. For a future study, the questionnaire will be distributed to Harvard School of Dental Medicine dental students.
Assessing the Usage and Confidence in Oral Cancer Screenings at Tufts University School of Dental Medicine

Annie Rao,* Abigail Yazbak, Matthew Finkelman, Mark Lerman, Tanya Wright, and Archana Viswanath

Although oral cancer (OC) is not the most common type of cancer in the United States, its often late-stage diagnosis gives it one of the poorest prognoses. What is needed is more careful attention in the earlier stages by practitioners examining the oral cavity.

OBJECTIVES: To assess the knowledge and confidence with OC screening methods of undergraduate dental students at Tufts University School of Dental Medicine (TUSDM).

METHODS: All incoming fourth year dental students (N=210) at TUSDM were asked to complete a survey via Qualtrics to assess accuracy in diagnosing pictured lesions and comfort when interpreting biopsy reports and creating treatment plans for OC patients. Students were also asked if they have examined patients with diagnosed OC at TUSDM and if they would like more information about OC built into the TUSDM curriculum. Data from the experiment was analyzed using the chi-squared test (or Fisher’s exact test, in the case of sparse expected cell counts), where p<0.05 is significant.

RESULTS: Of the 54 responses, all participants routinely examined the oral mucosa of every patient and knew where malignant lesions are most often found within the mouth. Of these, 73% (35/54) felt that they have sufficient knowledge to identify patients at risk for OC and to identify potentially malignant lesions. However, only 22% (12/54) of students correctly diagnosed a pictured lesion. When asked about comfort of interpreting a biopsy report or taking appropriate follow-up action, 58% (28/54) of students rated themselves as uncomfortable. Of the students surveyed, only 31% (15/54) have had the opportunity to examine patients with malignant oral lesions at TUSDM. When participants were asked if they would like more pathology information built into the curriculum at Tufts, 88% wanted additional lectures or online materials.

CONCLUSIONS: Though fourth-year students at TUSDM feel comfortable identifying oral lesions, many still would like additional information regarding OC diagnosis, biopsy reporting, and treatment plans.
Tracking Facial Recovery in Patients with Facial Paralysis

Daniel Regan,*1 Tessa Hadlock,2 Duong Tran,1 Carroll Ann Trotman1
1Tufts University School of Dental Medicine; 2Harvard Medical School

OBJECTIVES: (1) To quantitatively determine the range of facial soft tissue disfigurement in patients with acute, unilateral, flaccid facial paralysis and track their recovery over time; and (2) to compare patients’ facial disfigurement with that of normal subjects.

METHODS: Three-dimensional (3D) static facial images of 64 control subjects (mean age 42.1 yrs., SD=14.4) and 31 patients with unilateral facial paralysis (mean age 44.3 yrs., SD=12.4) were captured using a 3dMDface System. Patients’ images were recorded at baseline, 3 weeks, and 12 weeks. Control images were recorded at baseline only. At each time-point, specific facial landmarks were digitized on the images, and distance measurements representing the difference between corresponding paralyzed and nonparalyzed sides of the face were made for the brow, superior lid, inferior lid, nasal base, and oral commissure regions, and for the philtrum position relative to the facial midline according to the method of Hadlock. Means and SD were calculated for each measurement at each time point.

Repeated measures ANOVA and Wilcoxon signed rank test were used to compare the measurements over time for the patients and for posthoc pairwise comparisons. Wilcoxon rank-sum test was used to test for significant differences between the patients and controls (p-value<0.05).

RESULTS: For the patients, all measurements were significantly different between the three time points except for the inferior lid: the means at baseline were greater than the means at 3 weeks, which were greater than the means at 12 weeks. There were significant differences between the patients and controls at baseline for resting brow, nasal base, oral commissure, and philtrum position, while at 3 weeks only the resting brow and philtrum position were significantly different. In both instances the means for the facial paralysis measurements were greater than the means for the controls.

CONCLUSIONS: In this sample, as expected, the patients were more disfigured than the controls with the greatest disfigurement in the brow region and philtrum position. The decrease in the 3D mean measurements from baseline to 12 weeks for the patients demonstrated recovery over time; however, at the 12-week period most patients fell short of the control distance and were not fully recovered. One inherent limitation of this method for quantifying facial paralysis is that it does not effectively localize the side of the disfigured regions.
Evaluation of Monobond® Plus with SpeedCEM® Plus for Orthodontic Purposes

Gregory Monfette, Timothy Reichheld,* Joseph Owen, Matthew Finkelman, Gerard Kugel, and Ronald Perry

OBJECTIVES: The purpose of this study was to assess the efficacy of Monobond® Plus (Ivoclar Vivadent) in conjunction with SpeedCEM® Plus (Ivoclar Vivadent) as an acceptable orthodontic bonding resin in the application of orthodontic brackets to ceramic and zirconia materials.

METHODS: To emulate porcelain crowns, IPS e.max® CAD rods (10 mm × 10 mm × 20 mm) (Ivoclar Vivadent) were created, and for zirconia, Jensen XT rods (10 mm × 10 mm × 40 mm) (Jensen Dental) were made. The control bonding agent is Assure PLUS® (Reliance Orthodontics) and the experimental is Monobond Plus. There were N=35 samples per group. For treatment 1, the surface was sandblasted and treated according to Figure 1. For treatment 2, the surface was etched using IPS® Ceramic Etching Gel (5% HF) (Ivoclar Vivadent) for twenty seconds, washed, and treated according to Figure 1. For treatment 3, the surfaces were sandblasted and light cured for 10 seconds, followed by treatment according to Figure 1. For treatment 4, material was sandblasted, followed by treatment according to Figure 1. All brackets were light cured for twenty seconds with radii Plus curing light (SDI Limited). Samples tested after 24 hours with an Instron® Universal Testing Machine (Norwood, Massachusetts) with 1K load cell and 1 mm/min cross-head speed.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Surface Bonded To</th>
<th>Bonding Agent</th>
<th>Cement</th>
<th>Bracket</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment 1</td>
<td>Porcelain</td>
<td>Assure Plus</td>
<td>SpeedCem Plus</td>
<td>Standard edgewise</td>
</tr>
<tr>
<td>Treatment 2</td>
<td>Porcelain</td>
<td>Brushed Monobond Plus</td>
<td>SpeedCem Plus</td>
<td>Standard edgewise</td>
</tr>
<tr>
<td>Treatment 3</td>
<td>Zirconia</td>
<td>Assure Plus</td>
<td>SpeedCem Plus</td>
<td>Standard edgewise</td>
</tr>
<tr>
<td>Treatment 4</td>
<td>Zirconia</td>
<td>Monobond Plus</td>
<td>SpeedCem Plus</td>
<td>Standard edgewise</td>
</tr>
</tbody>
</table>

RESULTS: Treatment 1 showed a statistically significant difference compared to treatment 2 (p=0.038). Treatment 3 showed a statistically insignificant difference to treatment 4 (p=0.715).

Table 1: Shear Bond Strength Comparison of Bonding Agents

<table>
<thead>
<tr>
<th></th>
<th>Assure Plus (MPa)</th>
<th>Standard Deviation</th>
<th>Monobond Plus (MPa)</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean SBS Material 1</td>
<td>24.68</td>
<td>10.92</td>
<td>26.86</td>
<td>1.08</td>
</tr>
<tr>
<td>Mean SBS Material 2</td>
<td>30.87</td>
<td>7.97</td>
<td>31.76</td>
<td>12.02</td>
</tr>
</tbody>
</table>

CONCLUSION: When zirconia is the substrate, the bonding agents were similar. On porcelain, a better bond was formed when Monobond Plus was used.
Altered Cell Behavior and Metabolism in Basal Cell Carcinoma Development

Arietta Rigopoulos,* Sara Mir, Sunnie Kuna, Tatiana Mendez, James Baleja, and Addy Alt-Holland

OBJECTIVE: Development of keratocystic odontogenic tumors (KCOTs) and numerous basal cell carcinomas (BCCs) are two of the traits that patients with basal cell carcinoma nevus syndrome (BCCNS) express throughout their life. Constitutive activation of the sonic hedgehog (SHh) pathway drives BCCs susceptibility, and SHh inhibitors successfully reduce BCC tumor burden in these patients. Nonetheless, cancer recurrence and emergence of drug-resistant tumors are associated with treatment cessation. Therefore, additional mechanisms, such as alterations in epithelial-stromal interactions and tumor cell energy metabolism, may also play an important role in BCC development. Here, we investigated the effect of epithelial-stromal cross-talk on behavior and metabolism of human BCC cells and dermal fibroblasts in vitro.

METHODS: BCC cells (ATCC TE 354.T) and fibroblasts were grown for 7–21 days either in individual cell cultures or separated by a barrier in co-cultures. Cell morphology and cytoskeleton organization were analyzed by bright-field microscopy and immunofluorescence. Nuclear magnetic resonance (NMR) was used to analyze culture conditioned media.

RESULTS: BCC cells demonstrated a variety of shapes with multiple membrane protrusions, whereas fibroblasts showed consistent, spindle-shape morphology. In BCC/fibroblast co-cultures, confluent areas of BCC cells exhibited growth of cells over each other, formation of extensive networks of actin fibers, and accumulation of multiple tumor sphere-like structures. Preliminary NMR analysis demonstrated that fibroblasts secreted more lactate and consumed more pyruvate than BCC cells, whereas in co-cultures lactate secretion and pyruvate consumption were markedly reduced. Relative to BCC cell cultures, glutamate secretion and glutamine consumption were increased in fibroblast cultures and in co-cultures.

CONCLUSIONS: In addition to abnormal activation of the SHh pathway in epithelial BCC cells, altered interactions between these cells and dermal fibroblasts within the tumor microenvironment can potentially impact BCC energy metabolism and cell behavior. Subsequently, these interactions may further predispose BCCNS patients to the development of BCCs, and possibly of KCOTs.

The study was funded by the Michael J. Rainen Foundation and supported by the Basal Cell Carcinoma Nevus Syndrome Life Support Network.
Microleakage Evaluation of Restorative Composite Materials

Marsha Robinson,* Jeffrey Daddona, Matthew Finkelman, Yoon Kang, and Gerard Kugel

OBJECTIVE: To compare the marginal microleakage at the interface of the tooth structure and restorative material according to ISO 11405:2015.

METHODS: Sixty standard class II cavity preparations, measuring 4 mm occluso-cervical, 1.5–2.0 mm mesiodistally and 3.0–4.0 mm bucco-lingually were prepared on human molars. A peri-probe was used to measure the final dimensions to maintain standard cavity size. Samples were randomly assigned to a study group (N=15): group 1, Bioactive Flowable Composite with Modified Calcium Phosphate (MCP) (Pulpdent); group 2, Filtek™ Bulk Fill Flowable Restorative (3M); group 3, Fuji II LC® (GC America); group 4, Beautifil II (Shofu). Materials were applied and cured (DEMI™, Kerr) according to manufacturers’ instructions. Samples were placed in distilled water 37°C for 24 hrs to ensure complete polymerization of the materials. Completed restorations were thermo-mechanically cycled for 10,000 cycles between 5°C and 55°C with a dwell time of 15 seconds. Samples were immersed in 2% methylene blue dye for two hours. Samples were embedded in acrylic resin, sectioned mesiodistally, and evaluated under a digital microscope (Olympus® SZX16). Microleakage was evaluated based on a whole number scale ranging from 0 to 4: 0=no leakage, 1=leakage into enamel only, 2=leakage penetrating into dentin, 3=leakage reaching the floor of the preparation, 4=leakage extending to the floor and penetrating the dentinal tubules. Counts and percentages were calculated, and statistical significance was assessed via generalized estimating equations (GEE) for comparison of materials.

RESULTS: Table 1 displays counts and percentages of microleakage scores. There was no statistically significant difference between groups (p=0.289).

Table 1: Distribution of Microleakage Scores by Group

<table>
<thead>
<tr>
<th>Evaluation of Microleakage Scale (0–4)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Group 1</td>
<td>0 (0.0%)</td>
</tr>
<tr>
<td>Group 2</td>
<td>0 (0.0%)</td>
</tr>
<tr>
<td>Group 3</td>
<td>0 (0.0%)</td>
</tr>
<tr>
<td>Group 4</td>
<td>0 (0.0%)</td>
</tr>
<tr>
<td>Total</td>
<td>0 (0.0%)</td>
</tr>
</tbody>
</table>

CONCLUSION: None of the materials tested exhibited a microleakage value of 0. All groups’ microleakage scores ranged from 1 to 3. However, only group 4 exhibited a microleakage score of 4, with the dye penetrating into the dentinal tubules. There was no significance shown between the materials tested.

Sponsored in part by Pulpdent Corporation.
Microleakage Evaluation of Conventional Liner Materials vs. Bioactive Liner Materials

Soroush Samimi,* Saam Bozorg,* Matthew Finkelman, Steven Eisen, Gerard Kugel

OBJECTIVE: To compare marginal microleakage at the interface of the tooth structure and restoration material using conventional and bioactive Liners according to ISO 11405:2015.

METHODS: Sixty standard class II preparations, measuring 3 mm occluso-cervical, 3 mm mesiodistally and 3 mm bucco-lingually, were prepared on de-identifiable human molars. Samples were randomly assigned to a study group (N=15) with each group receiving a different liner: Vitrebond™ Light Cure Glass Ionomer (3M™ ESPE™, Minnesota); GC Fuji LINING™ LC (GC America, Illinois); ACTIVA™ BioACTIVE-BASE/LINER™ (Pulpdent, Massachusetts). The fourth group did not receive any liner, as it was used as the control. Materials were applied and cured (DEMI™, KERR) according to manufacturers’ instructions. Samples were placed in distilled water 37°C for 24 hrs to ensure complete polymerization of materials. Completed restorations were thermo-mechanically cycled for 10,000 cycles between 5°C to 55°C with dwell time of 15 seconds. Samples were immersed in 2% methylene blue dye for two hours. Samples were embedded in acrylic resin, sectioned mesiodistally, and evaluated under a digital microscope (Olympus® SZX16). Microleakage was evaluated based on a whole number scale ranging from 0 to 4: 0=no evidence of dye penetration; 1=dye at the margin but less than one-third of the gingival width; 2=penetration along the margin beyond one-third of the gingival width up to the axial wall; 3=penetration along the axial wall. Counts and percentages were calculated, and statistical significance was assessed via generalized estimating equations (GEE) for comparison of materials.

RESULTS: Table 1 displays study results. The difference between group 1 and group 3 was statistically significant (p=0.007). Through statistical analysis, using Kruskal-Wallis test, the null hypothesis is rejected, p=0.037.

Table 1: Counts and percentages of microleakage scores (0-3)

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1 (Activa)</td>
<td>1 (6.7%)</td>
<td>2 (13.3%)</td>
<td>4 (26.7%)</td>
<td>8 (53.3%)</td>
<td>15 (100%)</td>
</tr>
<tr>
<td>Group 2 (VitreBond)</td>
<td>1 (6.7%)</td>
<td>2 (13.3%)</td>
<td>6 (40%)</td>
<td>6 (40%)</td>
<td>15 (100%)</td>
</tr>
<tr>
<td>Group 3 (GC Fuji)</td>
<td>5 (33.3%)</td>
<td>5 (33.3%)</td>
<td>3 (20%)</td>
<td>2 (13.3%)</td>
<td>15 (100%)</td>
</tr>
<tr>
<td>Group 4 (Control)</td>
<td>4 (26.7%)</td>
<td>2 (13.3%)</td>
<td>1 (6.7%)</td>
<td>8 (53.3%)</td>
<td>15 (100%)</td>
</tr>
<tr>
<td>Total</td>
<td>11 (18.3%)</td>
<td>11 (18.3%)</td>
<td>14 (23.3%)</td>
<td>24 (40%)</td>
<td>60</td>
</tr>
</tbody>
</table>

CONCLUSION: GC Fuji LINING™ LC demonstrated less incidence of microleakage in restorations comparing to ACTIVA™ BioACTIVE-BASE/LINER™, as well as all other groups.
Shear Bond Strength of Self-Adhesive Resin Cements: Pilot Study

Amanjot Sarao,* Jeffrey Daddona, Sarah Pagni, Cheen Loo

OBJECTIVES: The objective of this pilot study was to determine the shear bond strength (SBS) of four different self-adhesive resin cements bonded to dentin at 1 day, 30 days, and 60 days.

METHODS: In the study, 60 extracted molars were embedded in acrylic and prepared to expose the dentinal surface. Four products were tested after 24 hours, 30 days, and 60 days (N=5): group 1, TheraCem™ (Bisco); group 2, ACTIVA™ BioACTIVE (Pulpdent); group 3, Ceramir® Crown & Bridge (Doxa); group 4, Relyx™ Unicem (3M ESPE). Samples were stored in distilled water at 37°C and bonded according to manufacturers’ instructions. SBS was measured using the Instron®5566A (Norwood, Massachusetts) with 1K load cell and 1 mm/min cross-head speed. Statistical significance was determined with one-way ANOVA and Tukey’s HSD for pairwise comparisons.

RESULTS: Statistical analysis showed that at the 24-hour storage, there is a statistical difference in the SBS between groups 3 and 4 (p=0.02). At the 30-day storage, there is a statistical difference in the SBS between groups 2 and 4 (p=0.03) and between groups 3 and 4 (p=0.03). At the 60-day storage, there is a statistical difference in the SBS between groups 1 and 4 (p=0.02), between groups 2 and 4 (p=0.008), and groups 3 and 4 (p=0.02).

Table 1: Mean Shear Bond Strength

<table>
<thead>
<tr>
<th>Time</th>
<th>Materials</th>
<th>Mean SBS (MPa)</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Day</td>
<td>1</td>
<td>8.85&lt;sup&gt;AB&lt;/sup&gt;</td>
<td>3.25</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>7.61&lt;sup&gt;AB&lt;/sup&gt;</td>
<td>5.04</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>5.74&lt;sup&gt;A&lt;/sup&gt;</td>
<td>4.67</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>15.85&lt;sup&gt;AB&lt;/sup&gt;</td>
<td>5.16</td>
</tr>
<tr>
<td>30 Day</td>
<td>1</td>
<td>8.19&lt;sup&gt;AB&lt;/sup&gt;</td>
<td>5.29</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>5.65&lt;sup&gt;A&lt;/sup&gt;</td>
<td>5.20</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>5.54&lt;sup&gt;A&lt;/sup&gt;</td>
<td>1.49</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>19.21&lt;sup&gt;B&lt;/sup&gt;</td>
<td>11.74</td>
</tr>
<tr>
<td>60 Day</td>
<td>1</td>
<td>2.83&lt;sup&gt;A&lt;/sup&gt;</td>
<td>2.05</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>1.86&lt;sup&gt;A&lt;/sup&gt;</td>
<td>2.06</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>2.65&lt;sup&gt;A&lt;/sup&gt;</td>
<td>1.96</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>11.60</td>
<td>7.36</td>
</tr>
</tbody>
</table>

Means sharing a letter are not statistically different at the 5% level for each time storage.

CONCLUSIONS: The SBS decreased for all of the products across the different storage times except for group 4 from the 1-day storage to the 30-day storage. The greatest statistical differences shown was at the 60-day storage, with group 4 displaying higher shear bond strength compared to groups 1, 2, and 3. Further research should be conducted.
The Importance of Advocacy and Leadership in Predoctoral Dental Curriculum

Zamone Sawyer,* Melissa Ing, Matthew Finkelman, and Britta Magnuson

OBJECTIVE: Dental schools aim to prepare students to understand the importance of political involvement and public health advocacy. The aim of this study was to survey TUSDM predoctoral students and assess their current knowledge of health policies and dental advocacy, while learning about their leadership involvement and willingness to become more politically engaged dental advocates.

METHODS: A survey was developed to assess TUSDM predoctoral students’ knowledge of dental policies, public health, and advocacy and to learn about their leadership involvement. Topics on barriers to care, midlevel providers, Medicaid and involvement in organized dentistry, and leadership were addressed. All questions were tested for face and content validity prior to distribution.

RESULTS: Students reported having adequately learned about public health policy in dental school with Year 1 (50.0%), Year 2 (51.5%), Year 3 (55.6%), Year 4 (43.8%) reporting strongly agree. Students reported having participated in advocacy events with Year 1 (20.0%), Year 2 (45.5%), Year 3 (14.8%), and Year 4 (31.3%). Students reported having a leadership position within an organization with Year 1 (28.0%), Year 2 (39.4%), Year 3 (40.7%), Year 4 (31.3%). Students were asked if they knew the name of the MA Medicaid program (MassHealth), with Year 1 (24.0%), Year 2 (45.2%), Year 3 (70.8%), and Year 4 (58.8%) responding correctly. No statistically significant differences were found between class years.

CONCLUSION: Students felt knowledgeable about public health concepts; however, students in the clinical years appeared most knowledgeable. Leadership positions were most commonly reported in Year 2 and Year 3. As students go through the curriculum they learn more about these subjects; however, it is important they are introduced early. Students reported wanting more of these topics added directly to the curriculum or delivered as a lunch and learn. A follow up to this study would be to implement these ideas.
Effects of Antibiotic Prophylaxis for Lateral Window Maxillary Sinus Augmentation

Yusuf Sheikh,* Sarah Pagni, Yong Hur, and Yumi Ogata

OBJECTIVES: Lateral window sinus augmentation is indicated in patients with inadequate alveolar bone height for dental implant placement in the atrophic posterior maxilla. Although many authors suggest the use of perioperative antibiotic prophylaxis for sinus augmentation, the effect of antibiotic prophylaxis has not yet been supported by scientific evidence. The aim of this retrospective study was to evaluate the effect of antibiotic prophylaxis by examining the incidence of postoperative infection and implant failure in patients who received lateral window sinus augmentation.

METHODS: Data was gathered from the electronic health records (EHRs) of patients who received lateral window sinus augmentations from July 1, 2006, to June 30, 2017, at Tufts University School of Dental Medicine. The following information was extracted: age, sex, smoking history, prophylactic antibiotics, postoperative infection, and implant failures. Generalized estimating equations were used to reveal statistical significance in the incidence of postoperative infection and implant failure between patients with and without the use of prophylactic antibiotics. Patient- and surgery-related variables associated with infection and implant failure were also assessed. This study protocol was approved by the Tufts Health Sciences Institutional Review Board.

RESULTS: In the study, 767 patients were initially identified in the EHRs. After exclusion of 336 patients, a total of 431 patients were included in the study. The incidence of postoperative infection was significantly less in patients who received antibiotic prophylaxis (2.54%) than those who did not receive antibiotic prophylaxis (10.53%) (p=0.02). With regard to the incidence of implant failure, a statistical significance (p=0.005) was found between patients who received prophylactic antibiotics before surgery (2.11%) and those who did not (12.50%).

CONCLUSIONS: Within the limitations of this study, patients requiring lateral window sinus augmentation for dental implants may benefit from the use of prophylactic antibiotics to prevent postoperative infections and implant failure.
Comparing the Working/Setting Times of Marked and Experimental Automix Tips

Peng Shi,* Duong Tran, Yoon Kang, Jeffrey Daddona, Katie Dunn, and Gerard Kugel

OBJECTIVE: To confirm if using a different automix tip has an effect on working and setting time.

METHODS: Each material, impression, and bite registration (N=14) as well as restorative materials (N=9) was tested with new and current automix tips (3 tips per group). Working and setting time were measured through the use of the Universal Test Machine (Instron®5566A, Norwood, Massachusetts). The materials were extruded into a cylinder (height of 5 cm and width of 1.67 cm for impression/bite-registration materials and height of 3 cm and width of 0.95 cm for restorative materials). Excess materials were removed by leveling off the top edge of the tube with a flat knife. The Intron then moved down at a crosshead speed of 1.1 mm/second and was set to stop at 20N load. Once the materials set, the Intron stopped when resistance exceeded 20N. The distance traveled represents the setting time. Working time was determined on the force vs. time graph produced by the Intron software, by measuring the time span of the linear portion of the graph before the material becomes more viscous. Both working and setting time were observed at room temperature. Mean and standard deviation was determined for working time and setting time of material. A t-test was used to compare the marketed and experimental automix tips. Bonferroni correction was used to adjust for multiple comparison, and significant level was set at 0.002.

RESULTS: For the 14 types of impression and bite registration materials and the nine types of restorative materials tested, no significant difference was found between marketed and experimental tips as far as the working and setting time is concerned.

CONCLUSIONS: Working and setting time of all tested materials were not significantly different when using either marketed or experimental automix tips.

Table 1: Working and setting time for impression and bite-registration materials

<table>
<thead>
<tr>
<th>DenMat® Product</th>
<th>Working Time of Marketed Tips (mm:ss) (SD)</th>
<th>Working Time of Experimental Tips (mm:ss) (SD)</th>
<th>P-value</th>
<th>Setting Time of Marketed Tips (mm:ss) (SD)</th>
<th>Setting Time of Experimental Tips (mm:ss) (SD)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Splash!* Cartridges</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regular Set</td>
<td>3:58 (20)</td>
<td>3:50 (20)</td>
<td>0.66</td>
<td>6:26 (27)</td>
<td>6:17 (14)</td>
<td>0.62</td>
</tr>
<tr>
<td>Half-Time Set</td>
<td>2:06 (4)</td>
<td>2:02 (5)</td>
<td>0.29</td>
<td>3:26 (8)</td>
<td>3:22 (11)</td>
<td>0.61</td>
</tr>
<tr>
<td>Splash Max Cartridges</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lite Body</td>
<td>3:32 (7)</td>
<td>3:30 (5)</td>
<td>0.74</td>
<td>6:54 (14)</td>
<td>6:50 (19)</td>
<td>0.74</td>
</tr>
<tr>
<td>Half-Time Set Lite Body</td>
<td>2:03 (5)</td>
<td>2:05 (4)</td>
<td>0.58</td>
<td>3:33 (6)</td>
<td>3:46 (7)</td>
<td>0.05</td>
</tr>
<tr>
<td>Precision® Cartridges</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lite Body</td>
<td>2:51 (8)</td>
<td>2:44 (4)</td>
<td>0.23</td>
<td>4:03 (16)</td>
<td>4:07 (8)</td>
<td>0.71</td>
</tr>
</tbody>
</table>
### Predoctoral Student Presentations

<table>
<thead>
<tr>
<th>DenMat® Product</th>
<th>Working Time of Marketed Tips (mm:ss) (SD)</th>
<th>Working Time of Experimental Tips (mm:ss) (SD)</th>
<th>P-value</th>
<th>Setting Time of Marketed Tips (mm:ss) (SD)</th>
<th>Setting Time of Experimental Tips (mm:ss) (SD)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PERFEC Temp® II Cartridge A2</td>
<td>1:24 (2)</td>
<td>1:24 (1)</td>
<td>0.82</td>
<td>1:42 (6)</td>
<td>1:47 (2)</td>
<td>0.26</td>
</tr>
<tr>
<td>Perfectemp 10® Cartridge A2</td>
<td>1:12 (1)</td>
<td>1:12 (1)</td>
<td>0.40</td>
<td>1:22 (1)</td>
<td>1:26 (2)</td>
<td>0.07</td>
</tr>
<tr>
<td>Core Paste® Syringeable White Self-Cure</td>
<td>1:22 (3)</td>
<td>1:24 (3)</td>
<td>0.49</td>
<td>1:31 (7)</td>
<td>1:44 (6)</td>
<td>0.07</td>
</tr>
<tr>
<td>Core Paste® Syringeable Enamel Dual-Cure</td>
<td>3:1 (12)</td>
<td>3:34 (10)</td>
<td>0.02</td>
<td>3:31 (10)</td>
<td>4:16 (16)</td>
<td>0.01</td>
</tr>
<tr>
<td>Core Paste® Syringe XP Enamel</td>
<td>3:55 (15)</td>
<td>3:52 (6)</td>
<td>0.76</td>
<td>4:03 (14)</td>
<td>4:14 (12)</td>
<td>0.36</td>
</tr>
<tr>
<td>Core Paste® Syringe XP White</td>
<td>3:29 (10)</td>
<td>3:34 (14)</td>
<td>0.66</td>
<td>3:49 (7)</td>
<td>3:59 (11)</td>
<td>0.25</td>
</tr>
<tr>
<td>Geristore® Dual Cure Resin Ionomer Syringe Kit A2</td>
<td>3:13 (25)</td>
<td>3:46 (12)</td>
<td>0.10</td>
<td>3:38 (22)</td>
<td>4:17 (19)</td>
<td>0.08</td>
</tr>
<tr>
<td>Infinity™ SE Syringeable Kit</td>
<td>2:15 (17)</td>
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Perspective on the Use of Learning Catalytics in the Curriculum

Benjamin Smith,* Irina Dragan, Sarah Pagni, Jennipher Murphy, and Nadeem Karimbux

OBJECTIVES: Incorporating technology in dental education by the use of student response systems aims to increase active learning inside the classroom. At Tufts University School of Dental Medicine (TUSDM), Learning Catalytics (LC) has experienced a consistent expansion in first-, second-, and third-year dental courses since its introduction in 2013. Despite these increases in the use of LC throughout TUSDM, no objective data from students and faculty have been recorded on LC use in the curriculum. This study analyzes the use of LC at TUSDM over time and the perceptions of students and faculty using this tool in the classroom, evaluated by a validated survey instrument.

METHODS: After receiving ethical approval, surveys were distributed to all second-, third-, and fourth-year students and course directors at TUSDM using Qualtrics. The outcomes assessed included perspectives of both students and faculty on how the use of LC has affected knowledge retention, academic performance, class participation, interest level/engagement, and class attendance. The Wilcoxon rank-sum test was used to analyze the survey responses.

RESULTS: Both faculty and students find that LC highlights and identifies important lecture concepts (median=9, median=8), is beneficial to student’s overall understanding and retention of course materials (median=8, median=7), and keeps students more interested and engaged during lectures (median=9, median=8). All participants strongly agree that LC enhances critical thinking skills, especially faculty members (median=10, p=0.006). Faculty members report that the most common reason for LC use is to increase knowledge retention.

CONCLUSIONS: Our data shows that both students and faculty value using LC in the didactic setting. Future studies may assess the use of LC on objective measures such as exam scores and overall GPA.
An Assessment of Patients with Nonsyndromic Tooth Aplasia and Gonial Angle Size

George Tsougranis,* Steven Tucker,* Lokesh Suri, Tamar Roomian, and Georgios Kanavakis

OBJECTIVES: The aim of this retrospective investigation is to analyze gender, number of missing teeth, and regions of missing teeth to determine if the difference in gonial angle between patients with nonsyndromic tooth aplasia is dependent on these parameters.

METHODS: In this study, there is data for 52 aplasia subjects (27 female and 25 male). The subjects will be subdivided into male and female categories. With these categories, stratified analysis will be done to determine if the difference in gonial angle size in aplasia subjects in comparison to their matched control subjects is dependent on gender. With the 52 aplasia subjects, the patient's panoramic radiographs will be used to identify the number of missing permanent teeth. Patients with two or more congenitally missing teeth will comprise one group, and those with fewer than two missing teeth will make up the second group. An analysis with the matched control subjects will be done to determine if the difference in gonial angle size is dependent on the number of congenitally missing teeth. By identifying the number of missing teeth, it will also be noted from which region of the mouth (upper posterior, upper anterior, lower posterior, lower anterior) the tooth/teeth are missing. With the known region, an analysis will be done to identify if any association exists between gonial angle size and missing teeth in the lower posterior region of the mouth vs. the rest of the regions.

RESULTS: After statistical analysis, it was found that there was no difference between gonial angle size and: 1) patient gender, 2) number of missing teeth, 3) lower posterior missing teeth vs. the rest of the mouth. Analysis will need to be done with a larger sample to determine if any differences exist.

CONCLUSION: No significant differences were found in gonial angle size between the mentioned parameters.
Clinical Performance of CAD/CAM Generated All-Ceramic Crowns

Delaney Turner,* Ali Muftu, Francois Fisselier, Tamar Roomian, and Maria Avrampou

OBJECTIVES: The aim of this retrospective chart review study was to assess the clinical performance of CAD/CAM generated all-ceramic crowns that were fabricated at Tufts University School of Dental Medicine (TUSDM). The survival, failure, and complication rates were evaluated.

METHODS: An electronic search was conducted to identify 110 randomly selected patients’ records treated in the predoctoral clinic at TUSDM between January 1, 2010, and July 19, 2017. Only patients who received full coverage in-house fabricated all-ceramic CAD/CAM crowns and had at least one recall visit were included in this study. Clinical notes and radiographs were evaluated at delivery day (baseline) and recall visits. Subject-level (age, gender, parafunction) and tooth-level (site, date of crown delivery, type of material, impression technique, existence of RCT and post and core, cementation) data were collected. Biological (tooth integrity, caries, endodontic problems) and technical parameters (crown fracture, loss of retention, ceramic chipping) were recorded in order to evaluate clinical performance of the CAD/CAM restorations.

RESULTS: Data from 47 subjects (24 female, 23 male) met the inclusion criteria and were analyzed. The mean age of the patients at the time of crown delivery was 53.6 years (SD±6.8). The median number of recall visits was 3 (IQR=3). IPS e.max CAD® and IPS Empress® (Ivoclar/Vivadent) materials were used for the fabrication of the CAD/CAM crowns using E4D and CEREC technology. Survival rate was 95.74% with a median follow-up time of 20.2 months (IQR=25.9). Out of the 47 restorations, two restorations failed and had to be replaced due to complications (loss of retention and fracture of the restoration).

CONCLUSIONS: CAD/CAM crowns fabricated in the predoctoral clinic at TUSDM demonstrate high short-term survival rates indicating promising clinical performance.
Promoting and Assessing Leadership Skills during BaSiCSsss Course at TUSDM

Anne-Marie Vu,* Andy Tran, Nadeem Karimbux, Sarah Pagni, and Irina Dragan

OBJECTIVES: During the Tufts University School of Dental Medicine (TUSDM) course entitled Basic Science/ Clinical Science Spiral Seminar Series (BaSiCSsss), students from all four years are assigned in teams and present a clinical case. The objective of this study was to assess leadership skills and compare the assessment forms submitted by the team leader (fourth-year dental students) and the team members (first-, second-, and third-year dental students) during the BaSiCSsss course.

METHODS: After ethical approval was received, investigators analyzed de-identified peer assessments and self-assessments forms. The surveys were stored in the Tufts Box Collaborative database. Quantitative data was reported as descriptive statistics (means and percentages) using a scale of five answer choices. Qualitative data assessment reported themes and subthemes amongst answers. Each theme was assigned a code in order to facilitate the analysis. Postsurvey analysis was completed using NVivo software program.

RESULTS: A total of 781 dental students completed the assessment surveys. The majority of the participants acknowledged that the compiled presentation was clear and organized as a result of the team effort. Variables reported that facilitated the team effort were: efficient time management (98%) or strong leadership skills of the fourth-year dental student (77%). Based on the self-assessment analysis, 56% of the leaders strongly agreed that they communicated early and often, making sure the assignments were clear. The word cloud analysis using NVivo showed that the focus of the project was centered around the patient, case, and working in a team.

CONCLUSION: The future of dentistry seems to be leading towards group practice and dentists working as leaders of a team. With this understanding, it is best to develop the essential skills during dental school. The results of this study may hopefully be used as a guide to enhance leadership skills in future students.
Geriatric Patient Care at Tufts University School of Dental Medicine: Population Trends in Mental Illness Diagnoses and Associated Use of Psychotropic Medications

Jessaca York,* Bhavik Desai, and Ronald Kulich

OBJECTIVES: Geriatric dental patients, defined as adults over 65 years, report on average two or more chronic medical comorbidities that may demand modifications in their outpatient dental care. The World Health Organization reports that though often overlooked, mental illness is now also becoming more and more prevalent among elderly adults, with over 20% of them suffering from a mental or neurological disorder (excluding headache disorders) and 6.6% of their handicaps and disabilities attributed to neuropsychiatric disorders. The aim of this study was to evaluate the prevalence of mental illness and psychotropic medication use among geriatric patients at the Tufts University School of Dental Medicine (TUSDM) across advancing age ranges: young old (65–74.9); old (75–84.9); and oldest-old (>85).

METHODS: Patient records of geriatric adults were reviewed from TUSDM's axiUm electronic health record database for the calendar years 2013, 2014, and 2015. Patients were subdivided into young-old, old, and oldest-old. For each age category, mental health diagnoses and psychotropic medication use among patients was recorded.

RESULTS: Pending; statistical analyses in process.

CONCLUSIONS: Pending; statistical analyses in process.
**POSTDOCTORAL STUDENT PRESENTATIONS**

Decellularized Tooth Bud ECM Silk Scaffolds Promote Dental Cell Differentiation

Mohammed Barashi,*1 Weibo Zhang,1 Nelson Monteiro,1 Whitney Stoppel,2 David Kaplan,2 Carroll Ann Trotman,1 and Pamela Yelick1

1Division of Craniofacial and Molecular Genetics, Department of Orthodontics, Tufts University School of Dental Medicine, Boston; 2Department of Biomedical Engineering, Tufts University, Medford, Massachusetts

**OBJECTIVE:** Tooth loss can be caused by multiple things, including caries, periodontal disease, trauma, and genetic disease. Dental pulp has important functions to sustain teeth by providing nutrient and oxygen supply, innervation, and immune response. Our objective was to determine whether incorporating extracellular matrix 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 passage two were seeded into silk scaffolds (3 × 10^5 cells/scaffold, ~3 × 10^3 cells/mm^3) and cultured in vitro in osteogenic media for 24 hours or for two and four weeks. Unseeded silk scaffolds were used as controls. Three replicates were used for each experimental condition and controls.

**RESULTS:** Histological analyses of paraffin embedded and sectioned constructs revealed pDMSC attachment and proliferation after two- and four-week in vitro culture. Immunofluorescent (IF) analysis showed robust dentin sialoprotein (DSP) expression in all pDMSC seeded silk scaffolds. DSP expression was enhanced in scaffolds containing tECM. Statistical analysis demonstrated significant differences in DSP expression in scaffolds with versus without tECM (p≤0.01).

**CONCLUSIONS:** Silk scaffolds supported the attachment, proliferation, and differentiation of seeded pDMSCs. Furthermore, our research is the first study to demonstrate that tECM can enhance the pDMSC differentiation, suggesting that tECM incorporated scaffolds show promise for dental pulp and/or whole tooth regeneration. Studies of in vivo implanted constructs are being performed to further investigate the effect of tECM on DMSC differentiation and mineralized tissue formation.

*Supported by NIH/NIDCR/NIBIB Award R01DE016132 (PCY).*
Creating a Standardized Patient-Reported Outcome Instrument for Implant-Supported Overdenture Procedures
Alyssa Fontaine, Kristina Hatzipetrou, Pardis Koleini, Alan Kuo, and Sarah Treff

OBJECTIVE: The objective of our project was to create a standardized instrument to measure patient-reported outcomes after receiving implant-supported overdentures by using the existing FACE-Q instrument as a basis. This standardized instrument was designed to be useful in both clinical and research settings.

METHODS: The FACE-Q instrument, which was recently developed to measure patient outcomes after plastic surgery procedures, was used as a basis for the creation of our questionnaire. The existing dental literature was then reviewed to determine which outcome parameters regarding patient satisfaction and quality of life were of high importance in cases of implant supported overdentures. A panel of TUSDM clinical faculty was also consulted to refine the selected parameters.

RESULTS: A study instrument that utilized the basic framework of the FACE-Q was successfully created. The study instrument can be completed in as little as ten minutes, making it feasible for patients to complete in a clinical setting. The study instrument also includes components assessing patients' pre-operative expectations and psychological states, which could help clinicians to tailor their treatment towards the patient's specific desires. Final study results are pending implementation in the clinical setting.

CONCLUSION: Although significant research has been done in the area of patient satisfaction and quality of life after receiving implant-supported overdentures, each study used its own unique instrument for assessing outcomes, making it difficult to compare results across studies. Our instrument can provide a standardized measure of patient-reported outcomes that is streamlined and user-friendly. Our instrument can also be useful in a clinical setting, allowing clinicians to gauge their patients' wants and expectations prior to dental procedures and helping to ensure better patient outcomes and satisfaction. With minor modifications, our study instrument is flexible enough also be used for other major dental procedures as well.
Dental Disease and Morbidity in Cardiac Surgery Procedures
Danielle Konrad, Wenyu Qu, Anya Wolfe, Alex Wong, and Stanley Ye

BACKGROUND: Comprehensive care in the treatment of cardiac patients prior to invasive cardiac procedures now often includes a dental team in a complete list of pre-operative surgery clearances. Until recently, there has been insufficient literature on the subject of dental infection related to dental clearance prior to cardiac surgery to provide a guideline for care.

OBJECTIVE: To search and review evidence-based literature regarding dental infection and complications of cardiac surgery. To provide comprehensive evidence to educate the interdisciplinary team, and provide a bridge between oral health and systemic health to best serve our patients as a whole. To aid in minimizing complications that may arise postoperatively after major cardiac surgery due to preventable dental complications.

DESIGN: Search titles with the words “dental abscess,” “dental infection,” and “postoperative cardiac complication.” Review of peer review and current literature on the risk and benefits of dental extractions preoperatively to prevent postoperative cardiac surgery complications.

RESULTS: Pending.

CONCLUSIONS: There is insufficient data to provide a statistically relevant cause and effect of dental infections and postoperative complications following cardiac surgery. However, studies suggest that the treatment of active dental infections prior to major cardiac surgery can be a successful factor in the elimination of morbidity post cardiac surgery.
Assessment Skills for Primary Medicine Oral Health Exams for Geriatric Patients

Lauren Gallant, Julissa Guerra Percolla, Darren Smith, and Monica Stiteler

PURPOSE: To gather literature to support primary care geriatrician healthcare provider training in fundamental oral health, thus helping providers in the assessment of oral health conditions/indicators that geriatric patients could develop in a long-term care facility setting.

AIM: To offer an educational and instructional resource for primary care geriatric health care providers to follow to effectively assess oral health conditions/indicator for senior patients in long-term care facilities.

STUDY DESIGN: Literature review of relevant material for interprofessional oral health instructional education for the benefit of geriatric populations living in long-term facilities. Furthermore, the study will provide a pre- and postsurvey of primary care team members for the assessment of oral healthcare knowledge.

HYPOTHESIS: It is beneficial for primary care geriatric health providers to be trained in oral health conditions/indicators as it relates to and affects the overall health of the elderly.
Hydrochloric Acid Cycle Exposure Effect on Microleakage of Resin Cements

Sarah Nessief,* Vasiliki Tsakalelli, Aikaterini Kostagianni, Sarah Pagni, and Ala Ali

OBJECTIVE: To evaluate microleakage of different resin cements after immersion of zirconia-reinforced lithium silicate crowns (ZLS) in hydrochloric acid solution (HCl).

MATERIALS AND METHODS: Thirty extracted non-caries human molars were prepared for full coverage porcelain crowns. Teeth were randomized into three groups, one for each resin cement tested: Rely-X UniCem (3M, ESPE); Variolink Esthetic Dual-cure (Ivoclar Vivadent); and Panavia 21 (Kuraray America Inc.). ZLS crowns were designed and milled from Celtra Duo blocks using CEREC CAD/CAM system and then cemented to the prepared teeth using the assigned cement according to the manufacturers’ guidelines. Samples were thermal cycled between water temperatures of 5°C and 55°C for 5,000 cycles with a 15-second dwell-time after each temperature. In order to mimic one year of clinical time in a patient’s mouth, samples were subjected to 91 one-hour cycles in HCl (pH 2) followed by one hour in artificial saliva. After the 91 cycles were completed, the samples were submerged in 50% silver nitrate solution for 24 hours followed by a developer solution for eight hours. The samples were embedded in clear epoxy resin and sectioned in a buccolingual direction at 0.5 mm. Sections were analyzed by a stereomicroscope at a magnification of 10X. Proportion of microleakage was calculated by dividing the total length of the dye penetration by the total length of the restoration. Data were analyzed with the Kruskal-Wallis test.

RESULTS: There was no statistically significant difference in median microleakage among the three cements tested (p>0.05). Panavia 21 showed the highest median microleakage score (59.22%) followed by Rely-X UniCem (55.2%) and Variolink Esthetic (44.47%).

CONCLUSIONS: Within the limitations of this study, no proven evidence showed a statistically significant difference in microleakage among the tested resin cements when used in ZLS crowns immersed in hydrochloric acid.
Minimally Invasive Mucogingival Procedures: Assessing the Level of Evidence

Pooyan Refahi,* Kian Azarnoush, Amanda Nevius, Hossein Bassir, Nadeem Karimbux, and Irina Dragan

OBJECTIVE: The primary aim of this systematic review was to evaluate the level of evidence for the publications presenting root coverage procedures, utilizing minimally invasive mucogingival techniques: semilunar, tunneling, modified tunneling, vestibular incision subperiosteal tunnel access (VISTA), and pinhole.

MATERIALS AND METHODS: A search of different databases (PubMed, Cochrane, EMBASE, Scopus, ClinicalTrials.gov, WHO International Clinical Trials) was conducted in April 2017 in order to identify potential articles relevant to the topic. Following an approved protocol, two independent reviewers screened the compiled articles via title review, abstract review, and full text review. All study designs were considered, but only English articles were included. Assessment of the level of evidence was conducted using strength of recommendation taxonomy (SORT) criteria. All variables were coded in order to facilitate the statistical analysis, and kappa analysis was used to calculate the agreement between the two examiners.

RESULTS: The electronic search resulted in a total of 1,155 articles; following EndNote and manual deduplication, it resulted in a total of 729 articles. After title review (kappa value=0.5), abstract review (kappa value=0.5), and full text review (kappa value=0.88), a total of 82 articles were included in the analysis. The included articles presented a variety of study designs from case reports and case series to randomized controlled trials and systematic reviews. The majority of the studies presented the tunneling procedure (N=38); followed by modified tunneling (N=24) and semilunar (N=16) procedures. The highest level of evidence was for semilunar, tunneling, and modified tunneling procedures (classified as level A), followed by VISTA (level B) and pinhole (level C).

CONCLUSION: Based on SORT guidelines, there is a good level of evidence supporting the indications for semilunar, tunneling, and modified tunneling techniques for root coverage procedures. However, further studies are recommended for VISTA and pinhole techniques.
Using Evidence-Based Dentistry in the Clinical Management of Combined Periodontal Conditions

Samar Shaikh,* Irina Dragan, Amanda Nevius, Noshir Mehta, and Nadeem Karimbux

OBJECTIVE: This report proposes a framework to integrate evidence-based dentistry (EBD) in a systematic approach in the clinical management of a patient diagnosed with drug-induced gingival hyperplasia combined with generalized aggressive periodontitis.

BACKGROUND: This report illustrates the case of a 37-year-old female who presented to the Department of Periodontology at Tufts University School of Dental Medicine with enlarged, tender, bleeding gums and loose teeth combined with a history of uncontrolled hypertension treated with calcium channel blockers.

METHODS: Incorporating the EBD process, a new five-step framework is proposed: ask the clinical question, acquire the evidence, appraise the evidence, apply it in the clinical setting, and assess the subjective and objective outcomes. Articles on aggressive periodontitis and/or gingival enlargement were sought using the assistance of an expert librarian. The search was conducted on databases PubMed, EMBASE and Scopus.

RESULTS: Initial literature search lead to a result of 34 publications. Articles were reviewed by two clinicians, and 31 relevant articles were selected. Of these, 26 matched the levels of evidence initially agreed upon. Based on the scientific evidence, patient’s chief complaint, and clinical expertise, a decision tree highlighting treatment options was compiled. The outcomes of the clinical management revealed that combined conditions can be successfully treated to an extent with nonsurgical therapy before proceeding with surgical therapy.

CONCLUSION: Within the limitations of this study, integrating EBD concepts was a reliable method to treat an atypical case, where two severe periodontal conditions were combined: drug-induced gingival enlargement and generalized aggressive periodontitis.
EXHIBITION PRESENTATIONS

The Effect of Different Marginal Configurations and Scanning Powders on the Accuracy of the Marginal Adaptation of Zirconia Crowns

Wed Alyousef,* Matthew Finkelman, Khaled El Rafie, Yukio Kudara, and Ala Ali

INTRODUCTION: The purpose of this study was to compare the effect of finish line design and imaging materials on marginal adaptation of zirconia crowns.

MATERIALS AND METHODS: Two different marginal configurations were tested (1 mm chamfer, 1.5 shoulder) and three different types of imaging materials (3M high resolution powder, Vita powder spray, Sinbrio scanning paint) in various permutations. The sample size was determined to be 18 per group (N=18). Two typodonts were prepared and scanned using the 3M True Definition scanner and milled. A total of 108 zirconia crowns were milled. Finally, the replica technique and a high magnification microscope 92X were used to measure the marginal gap.

RESULTS: The means (standard deviation) for each group were: 13.04 (1.66) μm for the chamfer and 3M powder group; 12.34 (1.77) μm for the chamfer and vita powder spray group; 12.45 (2.01) μm for the chamfer and Sinbrio scanning paint; 11.63 (1.25) μm for the shoulder and 3M powder group; 12.70 (1.43) μm for the shoulder and vita powder spray group; and 12.05 (2.69) μm for the shoulder and Sinbrio scanning paint group. The difference between marginal preparation designs was not statistically significant (p=0.180), nor was the difference among imaging materials (p=0.826).

CONCLUSION: There was no significant difference between the finish line designs utilized and the types of imaging materials tested on the marginal adaptation of zirconia crowns.
Generation of a Zebrafish FOP Model

Melissa LaBonty* and Pamela Yelick

Fibrodysplasia ossificans progressiva (FOP) is a rare, autosomal dominant genetic disorder in humans characterized by the gradual ossification of fibrous tissues, including skeletal muscle, tendons, and ligaments. In humans, activating mutations in the Type I BMP/TGFβ family member receptor ACVR1 are associated with FOP. Zebrafish acvr1l, previously known as alk8, is the functional ortholog of human ACVR1. The objective of this work is to create and characterize the first adult zebrafish model for FOP, providing a useful tool to elucidate the molecular mechanisms driving heterotopic ossification (HO) in FOP and other human diseases. Constitutively active mutations in zebrafish acvr1l cause early lethal defects. Therefore, to study roles for activating acvr1l mutations in adult zebrafish, we used gateway cloning to create a vector containing the hsp70l heat shock promoter driving the expression of mCherry-tagged constitutively active Acvr1l (Q204D). Constructs were injected into single cell stage BMP response element reporter (Bre:GFP) zebrafish to create stable Tg(Bre:GFP); Tg(hsp70l:acvr1l_Q204D-mCherry) lines. Beginning at two weeks postfertilization, developmentally staged transgenic animals were subjected to daily one-hour heat shock treatments (3 weeks to 12 months) to induce Acvr1lQ204D expression. Micro-CT was used on whole animals to confirm FOP-like skeletal defects. Acvr1lQ204D-expressing animals displayed HO formation, abnormal spinal curvature, vertebral fusions, and malformation of pelvic fins, as compared to heat shocked Tg(Bre:GFP) animals and non-heat shocked controls. Histological stains (Safranin O and Hall and Brunt’s Quadruple Stain) were used to confirm the presence of cartilaginous proteoglycans and mineralized tissue formation in the HO lesions. These results suggest that heat-shocked Acvr1lQ204D-expressing adult zebrafish provide an informative model for human FOP.
Health Outcomes in the Treatment of Obstructive Sleep Apnea: An Updated Review

Mitra Marvasti-Sitterly,* Gerard Kugel, Irina Dragan, and Leopoldo Correa

INTRODUCTION: Obstructive sleep apnea (OSA) is a frequently encountered form of breathing sleep disorders in our daily practices. The most common treatment options for this condition are continuous positive air pressure therapy (CPAP) and mandibular advancement devices (MAD).

OBJECTIVE: The aim of this updated review is to shed light on the overall health outcomes in the treatment of OSA from a patient, provider, and institutional health prospective.

METHODS: The PICO question for this study was based on the following format: population (studies that report on OSA); intervention (treatment with MAD); comparison (treatment with CPAP); outcome (impact on overall health from various perspectives). One reviewer with the support of an expert librarian conducted an extensive search. PubMed was searched using MeSH terms related to the study objective. Peer reviewed articles were screened by title, abstract, and full-text review. Pertinent articles were selected and analyzed for overall health outcomes.

RESULTS: Based on the evidence available, both CPAP and MADs can affect a patient's overall health. Specific patient's predictors and comorbidities, along with their chief complaint, will guide the treatment plan options. Socioeconomically, patients with medical insurance may benefit of reduced costs if they use a CPAP, while reimbursement though dental insurance for MADs is not covered to an equal percentage. Proper diagnosis and treatment of OSA can reduce healthcare cost with an estimate of $11 billion per year. A collaborative relationship between physicians and dentists will facilitate best practices to treat patients suffering of OSA.

CONCLUSIONS: Recommendations of interprofessional collaborations between dentists and medical physicians are key for best practices. Appropriate diagnosis and treatment of OSA can have an increased impact on the overall health of our patients. Further high-level evidence studies are needed to support this topic of general interest.
Bioengineered Tooth Bud Constructs for Future Applications in Implant Dentistry

Elizabeth Smith,*1 Shantel Angstadt,1 Nelson Monteiro,1 Weibo Zhang,1 Ali Khademhosseini,2 and Pamela Yelick1

1Tufts University School of Medicine, Tufts University School of Dental Medicine, Boston; 2Division of Health Science and Technology, Harvard-MIT, Biomaterials Innovations Research Center, Brigham & Women’s Hospital and Harvard Medical School, Boston

OBJECTIVE: Our long-term goal is to enhance the quality of dental and oral health for those suffering from tooth loss by creating bioengineered functional, living replacement teeth as a superior alternative to currently used synthetic dental implants.

METHODS: For this study, we co-encapsulated postnatal dental cells and endothelial cells within GelMA hydrogel scaffolds to fabricate tooth bud constructs.

RESULTS: After two weeks of subcutaneous implantation, bioengineered tooth bud constructs exhibited proliferating dental epithelial (DE) rosette structures that expressed Sox2 and LEF-1, markers of the DE stem cell (DESC) niche. The putative bioengineered DESC also exhibited canonical Wnt signaling activation as demonstrated by robust Beta-Catenin and sonic hedgehog (SHh) expression and a co-expressed SHh and FGF3 signaling center resembling the natural enamel knot. The putative DESC niche was surrounded by a distinct basement membrane, and condensed dental mesenchymal cells that expressed Fibroblast Growth Factor 3 (FGF3) and de novo Fibrillin-2 expression, all hallmarks of naturally developing tooth buds. After 4W of in vivo growth, GelMA tooth bud constructs exhibited robust mineralized tissue formation that adopted the size and shape of the construct.

CONCLUSIONS: These high-impact results are the first to recapitulate the natural DESC niche and other features of natural tooth development using postnatal dental cells. These results are anticipated to improve the quality of dental and oral health for people suffering from tooth loss and facilitate a variety of regenerative medicine approaches to bioengineer functional organs and tissues.

This work was supported by NIH/NIDCR R01 DE016132 (PCY) and NIH/NIDCR F31 DE026361 (EES).
Behavioral, Epidemiologic, and Health Services

FACULTY ABSTRACTS

Note: Names marked with an asterisk denote presenter of paper.

BEHAVIORAL, EPIDEMIOLOGIC, AND HEALTH SERVICES RESEARCH

Item Ordering and Computerized Classification Tests with Cluster-Based Scoring: An Investigation of the Countdown Method

Matthew Finkelman,1 Sarah Lowe,2 Wonsuk Kim,3 Oliver Gruebner,4 Niels Smits,5 and Sandro Galea6

1Tufts University School of Dental Medicine, Boston; 2Montclair State University, Montclair, New Jersey; 3Measured Progress, Inc., Dover, New Hampshire; 4Robert Koch Institute, Berlin, Germany; 5University of Amsterdam, Amsterdam, Netherlands; 6Boston University School of Public Health, Boston

The countdown method is a well-known approach to reducing the average length of screening instruments that are presented by computer. In the countdown method, testing is terminated once the result of the screener (“positive” or “negative”) has been unambiguously determined from prior answers. Previous research has examined whether presenting dichotomously scored items in order from “least to most frequently endorsed” or “most to least frequently endorsed” is more efficient when the countdown method is used. The current study describes the mean score procedure, an extension of the above item ordering procedures to polytomously scored items, and evaluates its efficiency relative to the distribution of other possible item orderings in 2 real-data simulations. Both simulations involve item responses to the Posttraumatic Stress Disorder (PTSD) Checklist for DSM-5 (PCL-5). In the first simulation, items were scored polytomously, and a single cutoff point was used to determine the screening result. In the second simulation, items were converted to dichotomous scores, as well as categorized into 4 clusters; a positive result for the entire assessment was obtained if and only if a positive result was obtained for each cluster. The latter simulation also investigated the effect of reordering the clusters themselves on the efficiency of the countdown method. Results indicated that the mean score procedure does not necessarily produce the optimal ordering, but tends to assemble an efficient item ordering relative to the distribution of possible orderings. In the second simulation, reordering the clusters themselves affected efficiency. Future research directions are suggested.

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Building Oral Health Research Infrastructure: The First National Oral Health Survey of Rwanda

John Morgan,1 Moses Isyagi,2 Joseph Ntaganira,2 Agnes Gatarayiha,2 Sarah Pagni,1 Tamar Roomian,1 Matthew Finkelman,1 Jane Steffensen,1 Jane Barrow,3 Chrispinus Mumena,2 and Donna Hackley1,2,3

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BACKGROUND: Oral health affects quality of life and is linked to overall health. Enhanced oral health research is needed in low- and middle-income countries to develop strategies that reduce the burden of oral disease, improve oral health, and inform oral health workforce and infrastructure development decisions.
OBJECTIVE: To implement the first National Oral Health Survey of Rwanda to assess the oral disease burden and inform oral health promotion strategies.

METHODS: In this cross-sectional study, sample size and site selection were based on the World Health Organization (WHO) Oral Health Surveys Pathfinder stratified cluster methodologies. Randomly selected 15 sites included 2 in the capital city, 2 other urban centers, and 11 rural locations representing all provinces and rural/urban population distribution. A minimum of 125 individuals from each of 5 age groups were included at each site. A computer assisted personal instrument (CAPI) was developed to administer the study instrument.

RESULTS: Nearly two-thirds (64.9%) of the 2,097 participants had caries experience and 54.3% had untreated caries. Among adults 20 years of age and older, 32.4% had substantial oral debris and 60.0% had calculus. A majority (70.6%) had never visited an oral health provider. Quality-of-life challenges due to oral diseases/conditions including pain, difficulty chewing, self-consciousness, and difficulty participating in usual activities was reported at 63.9%, 42.2% 36.2%, 35.4% respectively.

CONCLUSION: The first National Oral Health Survey of Rwanda was a collaboration of the Ministry of Health of Rwanda, the University of Rwanda Schools of Dentistry and Public Health, the Rwanda Dental Surgeons and Dental (Therapists) Associations, and Tufts University and Harvard University Schools of Dental Medicine. The international effort contributed to building oral health research capacity and resulted in a national oral health database of oral disease burden. This information is essential for developing oral disease prevention and management strategies as well as oral health workforce and infrastructure.

Published in Global Health Action, 11(1), 2018.

Neural Correlates of Conventional and Harm/Welfare-Based Moral Decision Making

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The degree to which social norms are processed by a unitary system or dissociable systems remains debated. Much research on children's social-cognitive judgments has supported the distinction between “moral” (harm/welfare-based) and “conventional” norms. However, the extent to which these norms are processed by dissociable neural systems remains unclear. To address this issue, 23 healthy participants were scanned with functional magnetic resonance imaging (fMRI) while they rated the wrongness of harm/welfare-based and conventional transgressions and neutral vignettes. Activation significantly greater than the neutral vignette baseline was observed in regions implicated in decision-making, including rostral/ventral medial frontal, anterior insula, and dorsomedial frontal cortices when evaluating both harm/welfare-based and social-conventional transgressions. Greater activation when rating harm/welfare-based relative to social-conventional transgressions was seen through much of ACC and bilateral inferior frontal gyrus. Greater activation was observed in superior temporal gyrus, bilateral middle temporal gyrus, left PCC, and temporal-parietal junction when rating social-conventional transgressions relative to harm/welfare-based transgressions. These data suggest that decisions regarding the wrongness of actions, irrespective of whether they involve care/harm-based
or conventional transgressions, recruit regions generally implicated in affect-based decision making. However, there is neural differentiation between harm/welfare-based and conventional transgressions. This may reflect the particular importance of processing the intent of transgressors of conventional norms and perhaps the greater emotional content or salience of harm/welfare-based transgressions.

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CLINICAL AND TRANSLATIONAL RESEARCH

Scoliosis in Fibrous Dysplasia/McCune-Albright Syndrome: Factors Associated with Curve Progression and Effects of Bisphosphonates

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Scoliosis is a complication of fibrous dysplasia/McCune-Albright syndrome (FD/MAS); however, risk factors and long-term outcomes are unknown. Bisphosphonates are commonly used; however, it is unknown whether their use decreases the risk of progressive scoliosis. Clinical data from the National Institutes of Health (NIH) cohort study was reviewed. Cobb angles were measured, and variables associated with scoliosis progression were identified. Of 138 subjects with available radiographs, 84 (61%) had scoliosis, including 55 (65%) classified as mild (Cobb angle >10 to ≤30 degrees), 11 (13%) as moderate (>30 to ≤45 degrees), and 18 (22%) as severe (>45 degrees). Total skeletal disease burden was highly associated with scoliosis severity (p<0.0001). Endocrinopathies associated with scoliosis included fibroblast growth factor 23 (FGF23)-mediated hypophosphatemia (p<0.001) and hyperthyroidism (p<0.001). Bone turnover markers, including osteocalcin and NTX-telopeptides, were associated with severe scoliosis (p<0.01). Associations were identified between Cobb angle and functional metrics, including leg length discrepancy (p<0.01), hip range of motion (p<0.05), and strength of the gluteus medius and maximus (p<0.01). Longitudinal analyses were conducted in 69 subjects who had serial radiographs over a median 4.9-year period (range: 0.9 to 14.7 years). Twenty-two subjects were treated with bisphosphonates; there was no difference in Cobb angle progression compared to untreated subjects (0.10 vs. 0.53 degrees/year, p=0.36). Longitudinal data was available for 10 of 12 subjects treated with spinal fusion; 1 had instrumentation failure, but in 9 subjects Cobb angles were stable with 6.1 years of follow-up (range: 0.9 to 14.7 years). Two fatalities from scoliosis-associated restrictive lung disease occurred in subjects managed nonoperatively. Scoliosis occurs frequently in patients with polyostotic FD and may be potentially fatal. The primary risk factor for progressive scoliosis is total skeletal disease burden. Treatable features that contribute to scoliosis progression include leg length discrepancy, FGF23-mediated hypophosphatemia, and hyperthyroidism. Current data do not support routine use of bisphosphonates to prevent progression of spinal curvature. Spinal fusion is frequently effective in providing long-term stability, and may be lifesaving.

CRANIOFACIAL BIOLOGY

Animal Models of Fibrodysplasia Ossificans Progressiva

Melissa LaBonty and Pamela Yelick

Fibrodysplasia ossificans progressiva (FOP) is a rare human disease of heterotopic ossification. FOP patients experience progressive development of ectopic bone within fibrous tissues that contributes to a gradual loss of mobility and can lead to early mortality. Due to lack of understanding of the etiology and progression of human FOP and the fact that surgical interventions often exacerbate FOP disease progression, alternative therapeutic methods are needed, including modeling in animals, to study and improve understanding of human FOP. In this review we provide an overview of the existing animal models of FOP and the key mechanistic findings from each. In addition, we highlight the specific advantages of a new adult zebrafish model, generated by our lab, to study human FOP.


New Zebrafish Models for Human Craniofacial and Skeletal Diseases

Pamela Yelick,1,* Melissa LaBonty,1 Viktoria Andreeva,1 Nicholas Pray,1 and Wolfram Goessling2

1Tufts University School of Dental Medicine, Boston; 2Harvard Medical School, Boston

OBJECTIVES: Our research focuses on mineralized tissue development, homeostasis, disease, and regeneration. Craniofacial and skeletal defects are prevalent birth defects, occurring in more than 1/700 live births. Craniofacial and skeletal defects can also result from cancer resections, sports injuries, accidents, and battlefield trauma, resulting in significantly reduced quality of life. To address this significant health concern, we use the zebrafish model to perform gene discovery and functional characterizations of molecular signaling pathways regulating normal and syndromic mineralized tissue development. We apply knowledge generated from studies in zebrafish to devise new strategies for the prevention and treatment of human mineralized tissue disease and to devise more effective tissue engineering strategies for the repair and regeneration of human mineralized craniofacial and skeletal tissues.

METHODS: We performed a large-scale, forward genetic, chemical mutagenesis screen in zebrafish to identify early lethal and adult viable mineralized tissue mutants. We used mineralized tissue staining, IHC/IF to characterize each mutant.

RESULTS: We identified a variety of zebrafish mutants as models for human mineralized tissue diseases including: Treacher Collins Syndrome; vertebral disc disease; scoliosis; hemifacial microsomia; midface hypoplasia; osteoporosis; degenerative disc disease; osteogenesis imperfecta (OI); and extremity malformations. We are currently performing next generation sequencing to identify candidate alleles for further validation studies.

CONCLUSIONS: We have successfully identified novel zebrafish mutants relevant to a variety of human craniofacial and skeletal diseases. These studies are anticipated to significantly improve our current knowledge and understanding of molecular signaling pathways regulating normal mineralized tissue development and disease and to provide inroads into new molecular targets and strategies to treat and prevent a variety of human mineralized tissue diseases.

These studies were supported by NIH/NIDCR R01DE018043 (PCY) and NIH/NIDCR R21 AR065761 (PCY). Presented at the 2018 AADR Annual Meeting in Fort Lauderdale, Florida. Abstract 1555.
DENTAL MATERIALS

Marginal Microleakage and Fracture Strength of CAD/CAM Lithium Disilicate Crowns

Ahmed Alhwaj,* Huda Stipho, Amit Sachdeo, Matthew Finkelman, and Ala Ali

OBJECTIVES: The objective of this in vitro study was to evaluate fracture strength and microleakage of CAD/CAM fabricated lithium disilicate posterior crowns cemented with RelyX™ Ultimate® and VariolinkII (V) resin cements.

METHODS: Fifty-four extracted human molars were prepared in a standardized manner for full crown coverage. The samples were scanned and designed using E4D system. The crowns were milled out of IPS e.max CAD blocks using E4D milling center. The samples were randomly divided into 4 groups; 1A, 1B, 2A, and 2B. For both the 1A and 1B groups, the crowns were cemented with V. For the 2A and 2B groups, the crowns were cemented with R. All groups were subjected to 5,000 thermocycles. Then, groups 1A and 2A were loaded until catastrophic fracture occurred. Groups 1B and 2B were immersed in silver nitrate dye then sectioned buccolingually and the microleakage were measured under a stereomicroscope at 1.25 magnification.

RESULTS: For fracture strength, the mean for group 1A was 2434.6 N (SD=531.8), and for group 2A, the mean was 2453.1 N (SD=471). The difference was not statistically significant (p-value=0.937). For microleakage, the median for group 1B was 11.4% (IQR=6.3%) and for group 2B, the median was 9% (IQR=8.7%). The difference was not statistically significant (p-value=0.438).

CONCLUSIONS: There was no evidence that the choice between RelyX Ultimate and Variolink II influences the microleakage and fracture strength of CAD/CAM fabricated lithium disilicate crowns. In addition, the lithium disilicate crowns’ fracture strength, using any of the 2 cements, was clinically acceptable.

Presented at the 2018 AADR Annual Meeting in Fort Lauderdale, Florida. Abstract 1577.

Effect of Acidic pH on Surface Roughness of Current Esthetic Dental Materials

Muhsen Alnasser,* Ala Ali, Matthew Finkelman, Aikaterini Papathanasiou, Marcelo Suzuki, and Ruby Ghaffari

OBJECTIVES: The aim of this study is to compare the surface roughness changes (Ra) of different CAD/CAM materials after exposure to hydrochloric acid (HCl) using a 3D optical interferometer.

METHODS: Five material groups were selected: IPS Empress CAD (Empress); BruxZir Solid Zirconia (Bruxzir); VITA Enamic (Enamic); IPS e.max CAD (e.max); and VITABLOCS Mark II CAD (Vitablocs). Specimens (N=18) were sectioned (2 mm thick), immersed (5% HCl), stored (37°C/45 h, 91 h), Ra measured (baseline, 45 h, 91 h), and statistically analyzed (Friedman, Wilcoxon signed-rank).

RESULTS: There were no statistically significant differences in Ra (baseline, 45 h, 91 h) for Bruxzir and e.max, however, Empress, Enamic, and Vitablocs demonstrated statistically significant differences.

CONCLUSIONS: Empress, Enamic, and Vitablocs showed significant increases in Ra, while Bruxzir and e.max exhibited the least change in Ra after exposure to HCl for 45 h and 91 h.

Presented at the 2018 AADR Annual Meeting in Fort Lauderdale, Florida. Abstract 0663.
Fracture Load of Screw-Retained Implant Crowns of Different Contours
Rashed Alsahafi,* Ala Ali, Matthew Finkelman, Hans-Peter Weber, Ronald Perry, and Aikaterini Papathanasiou

OBJECTIVES: To evaluate the effects that variations in cantilever length have on fracture strength and mode of failure of screw retained implant crowns.

METHODS: A scan body was mounted in a typodont with an implant replica located in the center of the space of tooth #30. The scan body was scanned using a chairside scanner. Computer software was used to digitally design 3 crowns for a mandibular first molar with different cantilever lengths. For group 1, the implant was located in the center of the crown. For groups 2 and 3, the implant position was repositioned 1.5 mm and 3 mm distally from the center, respectively. Then, 30 lithium-disilicate crowns were milled, 10 for each group. After firing, crowns were cemented to Vario-base with resin cement. Then, they were subjected to thermocycling for 10,000-cycles. Force of fracture and mode of failure were recorded.

RESULTS: After thermocycling, one sample from group 3 was eliminated due to crack development. Mean and (SD) fracture strength were as follows: group 1, 1,407 (454) N; group 2, 1,722 (311) N; and group 3, 1,708 (293) N. The difference between groups was not significant (p=0.113; one-way ANOVA). Fisher’s exact test comparing the groups’ mode of failure was significant (p<0.001). In post-hoc tests, the difference between groups 1 and 3 was significant (p<0.001), as was the difference between groups 2 and 3 (p<0.001), but there was no significant difference between groups 1 and 2 (p=0.474). For group 1, 100% of the specimens exhibited only ceramic fracture; for group 2, 20% of the specimens exhibited abutment fracture and abutment deformation, and 80% of the specimens had a ceramic fracture; for group 3, 67% exhibited abutment fracture and 33% exhibited ceramic fracture.

CONCLUSIONS: Crowns that have large cantilevering length should be handled with caution because of the increased chance for unfavorable fracture.

Presented at the 2018 AADR Annual Meeting in Fort Lauderdale, Florida. Abstract 1583.

Effect of Various Whitening Treatments on Mandibular Incisors
Jeffrey Daddona,* Anthony Falone, Zuhair Natto, and Gerard Kugel

OBJECTIVE: To evaluate the effect of different whitening treatments on the color parameters and shades of mandibular incisors.

METHODS: Fifteen extracted human mandibular incisors were randomly assigned to 1 of 3 groups (N=5): group 1, Crest® 3D WHITE™ Classic Vivid strips (Proctor & Gamble); group 2, Crest 3D WHITE strips (Proctor & Gamble); and group 3, Opalescence® Go 15% (Ultradent). Samples were placed in distilled water at 37°C for 24 hours. After 24-hour storage, baseline color coordinates (L*a*b*) were obtained and recorded using an Olympus® Crystaleye Spectrophotometer. Whitening treatments were conducted according to manufacturers’ instructions. All samples were stored in 37°C artificial saliva (KH₂PO₄ + NaN₃ + KCl + CaCl₂ + MgCl₂) between treatments. Final color coordinates were obtained and recorded using an Olympus Crystaleye Spectrophotometer. Pre- and post-treatment color parameters were averaged over 3 trials per sample to ensure the most accurate values. Overall incisor color difference (∆E*) was calculated by subtracting post-treatment L*a*b* values from baseline L*a*b* values. Two calibrated, double-blinded observers provided clinical shade values for each sample before and after the whitening procedures. Clinical shades were assigned a value from 1 to 16 using the VITA color scale.
RESULTS: Descriptive statistics were calculated for all groups’ color parameters (Table 1) and shade values (Table 2). One-way ANOVA was used to assess statistical significance. There were no significant differences observed in overall color change (ΔE*), color parameters (L*a*b*), or shade values (p-values>0.05) between the groups. Color, obtained through spectrophotometry, and observer’s shades were comparable.

Table 1: Color Data Analysis

<table>
<thead>
<tr>
<th>Group</th>
<th>Pre Treatment</th>
<th>Post Treatment</th>
<th>Shade Change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Clinical Shade Mean/SD</td>
<td>Clinical Shade Mean/SD</td>
<td>Shade Change Mean/SD</td>
</tr>
<tr>
<td>1</td>
<td>A3.5</td>
<td>C2</td>
<td>6.80±1.48</td>
</tr>
<tr>
<td></td>
<td>A4</td>
<td>C2</td>
<td>A3</td>
</tr>
<tr>
<td></td>
<td>C3</td>
<td>A3</td>
<td>B4</td>
</tr>
<tr>
<td>2</td>
<td>C4</td>
<td>A3.5</td>
<td>D3</td>
</tr>
<tr>
<td></td>
<td>A4</td>
<td>D3</td>
<td>A2</td>
</tr>
<tr>
<td></td>
<td>A3.5</td>
<td>C2</td>
<td>A2</td>
</tr>
<tr>
<td></td>
<td>A3</td>
<td>D2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>A4</td>
<td>C2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A3.5</td>
<td>B2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C3</td>
<td>A2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A4</td>
<td>B1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>D3</td>
<td>A2</td>
<td></td>
</tr>
</tbody>
</table>

Table 2: Clinical Shading Analysis

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean ΔE*/SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5.29±0.51</td>
</tr>
<tr>
<td>2</td>
<td>6.45±1.22</td>
</tr>
<tr>
<td>3</td>
<td>7.35±2.49</td>
</tr>
</tbody>
</table>

CONCLUSIONS: All samples observed a noticeable color difference after treatment, as shown by ΔE* values greater than 2.3. Samples in group 3 showed the greatest change in clinical shade by becoming an average of 9 shades whiter.

Presented at the 2018 AADR Annual Meeting in Fort Lauderdale, Florida. Abstract 1563.

Evaluation of Handling Properties of Dental Composite Materials

Yoon Kang, Tamar Roomian,* Katie Dunn, and Gerard Kugel

OBJECTIVES: To compare and evaluate the clinical handing and polishing characteristics of 3 commercially available dental composite materials by selected restorative dentists.

METHODS: Restorative dentists were selected based on the following inclusion criteria (N=24): 1. Current faculty appointment at Tufts University School of Dental Medicine, and 2. Practice restorative dentistry outside teaching institution. Three materials based on different filler types were evaluated: Nano composite (N): Filtek™ Supreme Ultra (3M Oral Care); Nano-Hybrid (NHC): BRILLIANT EverGlow* (Coltene); and Nano-Hybrid Dental Materials
(NHI): Tetric N-Ceram® (Ivoclar Vivadent). The participants were provided with instructions that dictated the randomized order and placement of the restorations, along with prepped Class I typodonts (#18, #19, and #30), curing light (Radii Plus, SDI), 3 blinded dental materials, burs, Alpen® Shapeguard Composite Plus polishing kits, 4 questionnaires, and an operative cassette. After each restoration, participants completed modified 4-point Likert scale questionnaires to evaluate the handling characteristics of the 3 blinded materials. A final and fourth questionnaire asked participants to rank 3 materials based on their overall preferences. Evaluation categories are listed in Table 1. Friedman test was used to determine if restorative dentists’ preferences differed.

RESULTS: Participants averaged 19.0 years of clinical experience. Table 1 presents the ranking of preferred materials according to the evaluation questions and overall preferences. The material preferred overall, based on handling characteristics, was NHC, which was preferred by 10 participants, followed by N being preferred by 8 participants, then NHI chosen overall by 6 participants. Table 2 shows the preference trend based on their years of practice.

Table 1: Number of dentists preferred composite types based on different handling criteria and overall preference

<table>
<thead>
<tr>
<th></th>
<th>NHC</th>
<th>N</th>
<th>NHI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marginal Sealing</td>
<td>10</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Separation from Instrument</td>
<td>12</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>Ease of Shaping</td>
<td>11</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>Polishing Ability</td>
<td>7</td>
<td>9</td>
<td>8</td>
</tr>
<tr>
<td>Time Needed to Complete</td>
<td>8</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Overall Preference</td>
<td>10</td>
<td>8</td>
<td>6</td>
</tr>
</tbody>
</table>

*16 out of 24 participating dentists recommended the provided polishing kit

Table 2: Number of dentists preferred composite types based on years of dental practice

<table>
<thead>
<tr>
<th>Number of Years Practiced</th>
<th>NHC</th>
<th>N</th>
<th>NHI</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–10 Years (n=4)</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>11–20 Years (n=10)</td>
<td>5</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>21–30 Years (n=6)</td>
<td>5</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>31+ Years (n=4)</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

CONCLUSIONS: Handling properties related to clinical performance of different dental materials were evaluated by restorative dentists in a simulated restoration procedure. The results of this study suggest that dental materials’ handling characteristics should be considered an important factor in materials development and manufacturing processing in achieving clinical success.

Presented at the 2018 AADR Annual Meeting in Fort Lauderdale, Florida. Abstract 1323.

Hydrochloric Acid Cyclic Exposure Effect on Microleakage of Resin Cements

Sarah Nassief, Vasiliki Tsakalelli, Aikaterini Kostagianni, Sarah Pagni, and Ala Ali

OBJECTIVES: To evaluate microleakage of different resin cements after immersion of zirconia-reinforced lithium silicate crowns (ZLS) in hydrochloric acid solution (HCl).
METHODS: Thirty extracted noncarious human molars were prepared for full coverage porcelain crowns. Teeth were randomized into 3 groups, 1 for each resin cement tested: Rely-X UniCem (3M, ESPE); Variolink Esthetic Dual-cure (Ivoclar Vivadent); and Panavia 21 (Kuraray America Inc.). ZLS crowns were designed and milled from Celtra Duo blocks using CEREC CAD/CAM system and then cemented to the prepared teeth using the assigned cement according to the manufacturers’ guidelines. Samples were thermal cycled between water temperatures of 5°C and 55°C for 5,000 cycles with a 15-second dwell-time after each temperature. In order to mimic 1 year of clinical time in a patient’s mouth, samples were subjected to 91 1-hour cycles in HCl (pH 2) followed by 1 hour in artificial saliva. After the 91 cycles were completed, the samples were submerged in 50% silver nitrate solution for 24 hours followed by a developer solution for 8 hours. The samples were embedded in clear epoxy resin and sectioned in a buccolingual direction at 0.5 mm. Sections were analyzed by a stereomicroscope at a magnification of 10X. Proportion of microleakage was calculated by dividing the total length of the dye penetration by the total length of the restoration. Data were analyzed with the Kruskal-Wallis test.

RESULTS: There was no statistically significant difference in median microleakage among the 3 cements tested (p>0.05). Panavia 21 showed the highest median microleakage score (59.22%), followed by Rely-X UniCem (55.2%) and Variolink Esthetic (44.47%).

CONCLUSIONS: Within the limitations of this study, no proven evidence showed a statistically significant difference in microleakage among the tested resin cements when used in ZLS crowns immersed in hydrochloric acid.

Presented at the 2018 AADR Annual Meeting in Fort Lauderdale, Florida. Abstract 1581.

Compatibility of One Universal Adhesive with Various Self-Curing Resin Cements

Ronald Perry1* and Astrit Kastrati2

1Tufts University School of Dental Medicine, Boston; 2Heraeus Kulzer GmbH

OBJECTIVES: To evaluate shear bond strength (SBS) on bovine dentine/enamel in accordance with ISO 16506 using a new All-in-One adhesive iBOND® Universal™ (IBU) (Kulzer GmbH) in combination with various adhesive resin cements Kuraray Panavia V5™ (KP), Ivoclar Variolink Esthetic™ (VE) and Kulzer Experimental ™ (KE) in self-cure mode compared to the self-adhesive 3M Relyx Unicem 2™ (RU) cement.

METHODS: Bovine incisors were halved and embedded in resin (N=5 dentine/enamel). A standard dentine/enamel surface was prepared by grinding with silicon carbide abrasive paper with a grit size of P120 and P400 under running water. IBU was applied in self-etch mode according to instructions for use and light cured (Translux® Wave, Kulzer GmbH). Composite cylinders (Venus® Diamond™) were luted on top of the bonded specimens using the different adhesive resin cements. The cements were used according to manufacturer specifications. The self-adhesive control cement RU was used directly on the tooth surface according to its instructions for use. Specimens were stored for 40 minutes under load and another 90 minutes without loading (37°C) for self-curing. The specimens were then stored at 37°C for 24 h in water. SBS was tested after 24 h or after additional thermo-cycling to simulate aging (5,000 cycles between 5°C/55°C with 30 s dwell time).

RESULTS: One-way ANOVA determined that there was a statistically significant difference between groups (p<0.0001). RU was statistically significantly when compared to the other groups. There was no statistically significant difference between RU and KP in the enamel after 24 h.
Table 1: Shear Bond Strength Test Results

<table>
<thead>
<tr>
<th>SBS [MPa] Bovine dentine after 24 h water storage at 37°C</th>
<th>RU</th>
<th>VE</th>
<th>KP</th>
<th>KE</th>
</tr>
</thead>
<tbody>
<tr>
<td>mean</td>
<td>2.0</td>
<td>33.2</td>
<td>33.5</td>
<td>34.3</td>
</tr>
<tr>
<td>standard deviation</td>
<td>2.8</td>
<td>12.5</td>
<td>10.6</td>
<td>8.6</td>
</tr>
</tbody>
</table>

RU significantly lower than all the other groups

<table>
<thead>
<tr>
<th>SBS [MPa] Bovine dentine after 24 h water storage at 37°C and 5,000 thermo cycles (5,000 cycles, 5–55°C, 30s dwell time)</th>
<th>RU</th>
<th>VE</th>
<th>KP</th>
<th>KE</th>
</tr>
</thead>
<tbody>
<tr>
<td>mean</td>
<td>0.7</td>
<td>37.5</td>
<td>31.9</td>
<td>31.0</td>
</tr>
<tr>
<td>standard deviation</td>
<td>0.4</td>
<td>5.5</td>
<td>8.4</td>
<td>10.7</td>
</tr>
</tbody>
</table>

RU significantly lower than all the other groups

<table>
<thead>
<tr>
<th>SBS [MPa] Bovine enamel after 24 h water storage at 37°C</th>
<th>RU</th>
<th>VE</th>
<th>KP</th>
<th>KE</th>
</tr>
</thead>
<tbody>
<tr>
<td>mean</td>
<td>12.8</td>
<td>30.0</td>
<td>20.9</td>
<td>23.7</td>
</tr>
<tr>
<td>standard deviation</td>
<td>2.0</td>
<td>6.4</td>
<td>4.7</td>
<td>5.7</td>
</tr>
</tbody>
</table>

RU significantly lower than VE and HK only

<table>
<thead>
<tr>
<th>SBS [MPa] Bovine enamel after 24 h water storage at 37°C and 5,000 thermo cycles (5,000 cycles, 5–55°C, 30s dwell time)</th>
<th>RU</th>
<th>VE</th>
<th>KP</th>
<th>KE</th>
</tr>
</thead>
<tbody>
<tr>
<td>mean</td>
<td>5.9</td>
<td>31.3</td>
<td>25.0</td>
<td>27.4</td>
</tr>
<tr>
<td>standard deviation</td>
<td>1.4</td>
<td>7.7</td>
<td>5.7</td>
<td>7.8</td>
</tr>
</tbody>
</table>

RU significantly lower than all the other groups

CONCLUSIONS: IBU was consistently compatible with all adhesive resin cements tested, with no adverse effects detected. KE resin cement performance was similar to VE and KP. RU without adhesive performed lower. Further testing is needed.

Presented at the 2018 AADR Annual Meeting in Fort Lauderdale, Florida. Abstract 0972.

Effect of Instruction, Light Curing Unit, and Location in the Mouth on the Energy Delivered to Simulated Restorations

Sara Samaha,1 Sapan Bhatt,1 Matthew Finkelman,1 Aikaterini Papathanasiou,1 Ronald Perry,1 Howard Strassler,2 Gerard Kugel,1 Franklin Garcia-Godoy,3,4 and Richard Price5

1Tufts University School of Dental Medicine, Boston; 2University of Maryland School of Dentistry, Baltimore, Maryland; 3University of Tennessee Health Science Center, Memphis, Tennessee; 4The Forsyth Institute, Cambridge, Massachusetts; 5Dalhousie University, Halifax, Nova Scotia, Canada

PURPOSE: To determine the amount of energy (Joules/cm²) delivered by students to simulated restorations in a patient simulator based on the restoration location, the curing light unit used, and before vs. after instruction on how to improve their light curing technique.

METHODS: Thirty dental students light cured 2 simulated restorations (that were 1 mm deep anterior and 4 mm deep posterior) using 3 light-curing units (LCUs): VALO, Bluephase G2, and Optilux 401. A MARC Patient Simulator was used to measure the irradiance (mW/cm²) received by the restorations in real-time to calculate the radiant exposure (J/cm²) delivered during a 20-second exposure. At first, students were asked to use the light curing technique that they had been previously taught. They were then given 5 minutes of additional
verbal instructions and a practical demonstration on proper curing technique using the patient simulator. They then light cured the restorations again. Based on a literature review, 16 J/cm² was considered the minimum acceptable radiant exposure.

RESULTS: Before receiving instruction on using the simulator, some students delivered as little as 4 J/cm² to the restoration. A mixed model test determined that the radiant exposure delivered to the anterior restoration was significantly greater than that delivered to the posterior restoration (p<0.001). Additionally, when the locations were compared for each LCU individually, a paired t-test determined that before the students received the additional instruction, the anterior restoration received a significantly greater radiant exposure than the posterior restoration for all 3 LCUs. Further paired t-tests and Wilcoxon signed-rank tests determined that after instruction, the radiant exposure improved significantly at both the anterior and posterior locations, for all 3 LCUs. The Bluephase G2 and the VALO each individually delivered 45% more radiant exposure than the Optilux 401 (p<0.001 for both). The Bluephase G2 and VALO lights delivered similar mean radiant exposures (25.4 J/cm² and 25.7 J/cm², respectively). This difference was not significant. Depending on the light unit used, at the posterior location, there was a 24 to a 52% increase in the mean radiant exposure that was delivered after instruction compared to before instruction.

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Zirconia Crown Accuracy on 3D Printed and Conventional Stone Models
Vasiliki Tsakalelli,* Abdalhalem Rages, Yukio Kudara, Matthew Finkelman, and Ala Ali

OBJECTIVES: To compare the marginal and internal adaptation of final restorations fabricated on 3D printed models and conventional stone models.

METHODS: Tooth #3 was prepared for an all-ceramic crown in a typodont Model (D95SDP-200, Kilgore, Michigan) and impressed using polyether impression material (Impregum Penta Soft Quick Step, 3M ESPE, Germany). Extra-hard dental epoxy resin material (EP85-215 dental epoxy, Eager Polymer, Chicago) was used to fabricate the reference model. Ten conventional polyether impressions of the reference model were taken and poured with dental stone type IV to fabricate the conventional stone casts (group 1). The reference model was scanned with the Trios Intraoral scanner (3shape, Copenhagen, Denmark) and 10 digital impressions (group 2) were printed by Bego Varseo 3D printer (Bego, Bremen, Germany) using the SLA technique. All models were scanned and Zirconia crowns were designed with the Exocad software, milled using the Schutz Tizian Cut 5® Milling Machine, and evaluated for marginal and internal adaptation. Descriptive statistics were calculated by group. The independent-samples t-test was utilized to compare the 2 groups in terms of internal and marginal discrepancy. The statistical software SPSS (Version 24) was utilized.

RESULTS: The conventional gypsum model group had a lower mean value (±SD) of marginal and internal discrepancy (45.5±4.4 μm) and (68.0±6.8 μm) compared to the 3D printed model group (46.1±5.2 μm) and (73.7±7.1 μm) respectively. The independent-samples t-test did not reveal any significant difference between the conventional and 3D printed models, p=0.679 for marginal discrepancy and p=0.086 for internal discrepancy.

CONCLUSIONS: Within the limitations of this study, 3D printed models and conventional stone models did not exhibit significant differences in terms of marginal and internal fit of final restorations fabricated on them.

Presented at the 2018 AADR Annual Meeting in Fort Lauderdale, Florida. Abstract 1587.
To Compare the Microleakage of Various Composite Repair Techniques

Christopher Wu,* Sunny Gaudet, Jeffrey Daddona, Steven Eisen, Sarah Pagni, and Gerard Kugel

OBJECTIVES: Comparing microleakage in defective composite restorations using different repair techniques as an alternative to total replacement.

METHODS: Fifty Class 1 restorations (4 mm × 4 mm × 3 mm) were prepared on extracted human molars. All teeth were etched (Ultra-Etch®, Ultradent), bonded (ExciTE®F, Ivoclar Vivadent), and restored (Filtek™ Supreme Ultra Universal Restorative, 3M Oral Care) according to manufacturers’ instructions. Following restoration, a notch (4 × 2 × 2 mm) was made between the tooth structure and the composite in the samples to simulate defects. Samples were randomly assigned into 5 groups (N=10) prior to repairing with composite: 1) no treatment (control); 2) etch and bond; 3) sandblast, etch, and bond; 4) roughened with diamond bur, etch, and bond; and 5) 2-step self-etch and bonding agent (Clearfil™ SE Bond) respectively. Samples were thermocycled for 10,000 cycles between 5°C and 55°C with a dwell time of 15 seconds, and immersed in 2% methylene blue dye for 2 hours. Microleakage between tooth structure and the new composite and between new composite and the existing composite were evaluated. A microleakage scale of 0 to 4 was used to measure 0%, 25%, 50%, 75%, and 100% of leakage respectively. Kruskal-Wallis test was used to analyze microleakage scores.

RESULTS: For composite-composite sites, there were differences in microleakage score between groups 2 and 3 (p=0.003), 1 and 4 (p=0.03, 3 and 5 (p=0.0004), and 4 and 5 (p=0.03) (see Table 1). For composite-tooth sites, there were differences in microleakage score between groups 2 and 5 (p=0.003) and between 3 and 5 (p=0.008) (see Table 2).

<table>
<thead>
<tr>
<th>Microleakage Scale</th>
<th>Group 1</th>
<th>0 (0)%</th>
<th>7 (70)%</th>
<th>1 (10)%</th>
<th>0 (0)%</th>
<th>2 (20)%</th>
<th>10 (100)%</th>
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<tr>
<td></td>
<td>Group 2</td>
<td>0 (0)%</td>
<td>8 (80)%</td>
<td>2 (20)%</td>
<td>0 (0)%</td>
<td>0 (0)%</td>
<td>10 (100)%</td>
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<td></td>
<td>Group 3</td>
<td>10 (100)%</td>
<td>0 (0)%</td>
<td>0 (0)%</td>
<td>0 (0)%</td>
<td>0 (0)%</td>
<td>10 (100)%</td>
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<tr>
<td></td>
<td>Group 4</td>
<td>7 (70)%</td>
<td>2 (20)%</td>
<td>0 (0)%</td>
<td>1 (10)%</td>
<td>0 (0)%</td>
<td>10 (100)%</td>
</tr>
<tr>
<td></td>
<td>Group 5</td>
<td>2 (20)%</td>
<td>1 (10)%</td>
<td>2 (20)%</td>
<td>4 (40)%</td>
<td>0 (0)%</td>
<td>9 (100)%</td>
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</tbody>
</table>

Table 2: Microleakage Counts and Percentages between Composite to Teeth

<table>
<thead>
<tr>
<th>Microleakage Scale</th>
<th>Group 1</th>
<th>0 (0)%</th>
<th>0 (0)%</th>
<th>0 (0)%</th>
<th>1 (10)%</th>
<th>9 (90)%</th>
<th>10 (100)%</th>
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<tbody>
<tr>
<td></td>
<td>Group 2</td>
<td>7 (70)%</td>
<td>1 (10)%</td>
<td>0 (0)%</td>
<td>0 (0)%</td>
<td>2 (20)%</td>
<td>10 (100)%</td>
</tr>
<tr>
<td></td>
<td>Group 3</td>
<td>4 (40)%</td>
<td>3 (30)%</td>
<td>2 (20)%</td>
<td>0 (0)%</td>
<td>1 (10)%</td>
<td>10 (100)%</td>
</tr>
<tr>
<td></td>
<td>Group 4</td>
<td>2 (20)%</td>
<td>3 (30)%</td>
<td>2 (20)%</td>
<td>0 (0)%</td>
<td>3 (30)%</td>
<td>10 (100)%</td>
</tr>
<tr>
<td></td>
<td>Group 5</td>
<td>0 (0)%</td>
<td>0 (0)%</td>
<td>0 (0)%</td>
<td>2 (20)%</td>
<td>7 (70)%</td>
<td>9 (100)%</td>
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</table>

CONCLUSIONS: When repairing composites, sandblasting prior to etch and bond has been shown to reduce microleakage when compared to the other techniques in the study.

Presented at the 2018 AADR Annual Meeting in Fort Lauderdale, Florida. Abstract 0958.
DIAGNOSTIC SCIENCES

Relationship between FACIT and Blood Values in Sicca and Sjögren's

Joseph Cimmino,* Mabi Singh, Athena Papas, and Zuhair Natto

OBJECTIVES: Fatigue and dryness are the most common complaints found in Sjögren's and sicca patients. To analyze the relationship between different blood values and functional assessment of chronic illness therapy (FACIT) scores in Sjögren's and sicca. A correlation between FACIT and EULAR Sjögren's Syndrome Disease Activity Index (ESSDAI) has been found in a clinical population that is significant to the 0.0001 level in 129 patients. Of the 129 patients, 39 of these had blood values that were available. The blood values were examined to determine if they were correlated with fatigue with concentration in inflammatory markers.

METHODS: In the study, 39 (2 males) patients with mean age of 61.3 (±11.7) for the sicca and 56.2 (±12.8) for Sjögren's were included. Of these, 18 patients were diagnosed with sicca and 21 were diagnosed Sjögren's. Reported blood values for WBC, absolute basophils, eosinophils, monocytes, lymphocytes, and neutrophil, RBC, HCT, Hb, platelets, creatinine, ESR, C3, C4, CK, CRP, cryoglobulin, IGG, IGM, IGA, ANA, SSA, SSB, and RF were measured. The mean of FACIT scores and ESSDAI sum scores were calculated. Pearson correlation (2 tailed) statistic was used to establish correlation between the FACIT and ESSDAI and blood values.

RESULTS: The mean FACIT scores calculated were 27.24 (±11.92) for sicca and 35.63 (±12.96) for Sjögren's. The mean ESSDAI scores were 5.28 (±4.96) for sicca and 10.24 (±13.19) for Sjögren's. The Pearson correlation showed FACIT correlated with IGG (p=0.02), and IGM (p=0.02). No other statistically significant correlations were found.

CONCLUSIONS: There may be a correlation between specific immunoglobulins and fatigue scores among sicca and diagnosed Sjögren's. Larger studies need to be conducted to establish this relationship.

Presented at the 2018 AADR Annual Meeting in Fort Lauderdale, Florida. Abstract 0931.

Quantifying Soft Tissue Shape and Symmetry:
Patients with Cleft Lip/Palate and Facial Paralysis

Carroll Ann Trotman,1 Julian Faraway,2 Tessa Hadlock,3 Caroline Banks,3 Nathan Jowett,3 and Daniel Regan1
1Tufts University School of Dental Medicine, Boston; 2University of Bath, Bath, Avon, England, 3Massachusetts Eye and Ear Infirmary, Boston

BACKGROUND: The objective of this study was to demonstrate simple 3-dimensional analyses of facial soft tissue shape and asymmetry.

METHODS: There were 2 study samples: one retrospective comprised patients with repaired cleft lip and palate (CL/P) and control subjects; and the other prospective comprised patients with unilateral facial paralysis (FP) and control subjects. The data collected were digitized 3D facial landmarks. Scores for shape and asymmetry of subjects' faces and for different facial regions were generated using Procrustes methods. Pivotal bootstrap methods and analysis of variance were used to test for significant differences in the scores between the patients and controls, and plots of the scores were generated to compare differences among the subjects.

RESULTS: (1) Shape scores: The CL/P patients demonstrated significant overall and regional facial differences (p=0.01). The patients were further from the control mean, especially those with unilateral CL/P. Patients with
Diagnostic Sciences

FP demonstrated significant differences (p=0.05) for the lower face only. (2) Asymmetry scores: CL/P and FP patients demonstrated significant overall and regional facial differences (CL/P, p=0.0001; FP, p=0.01). CL/P and FP patients were more asymmetric and were further from the control mean, and patients with unilateral CL/P were more asymmetric than the bilateral CL/P patients.

CONCLUSION: Clinicians can use the analyses to isolate differences and/or changes in the face due to shape or asymmetry, or a combination of both; based on the score plots, the extent of the shape and asymmetry differences can be compared among subjects and the extent of changes due to surgery measured.

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Global Networking: Meeting the Challenges, Facilitating Collaboration

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The constant change of information and technology advancement as well as the impact of social media has radically changed the world and education and, in particular, the needs of students, organizations, and disadvantaged communities who share the aim of training and providing quality healthcare services. Dental organizations and education centers around the world have recognized the importance of networking in delivering effective education to students, healthcare professionals, and communities. Networking is one way to meet the challenges of delivering healthcare education and services. This can be achieved by sharing of resources, expertise, knowledge, and experience to benefit all the stakeholders in healthcare delivery. The joint ADEE/ADEA Meeting in London on 8–9 May 2017 has facilitated discussions among dental educators from all over the world during a workshop on “Global Networking: The How and Why for Dental Educators.” The aim of this workshop was to determine how worldwide dental educators can network to share ideas, experience, expertise, and resources to improve both the curricula and the teaching and learning environment. A pre-conference survey was designed and implemented to identify the domains of interest and needs of participants. A structured questionnaire was administered, and this information was used to guide discussions on 3 main themes: curricula, faculty development, and mobility of faculty and students. Four questions were then defined to help group leaders to frame discussions in the 4 working groups. The 4 groups engaged in parallel discussions, with the ideas recorded and collated by group leaders, which later served for the thematic analysis across the groups to draw the key points discussed. Overall, a great desire and potential to create a global networking to share and gain support and expertise at individual and organizational level was apparent, and the working group has proposed an action plan, acknowledging that it requires great planning, effort, and commitment.

Published in European Journal of Dental Education, 22:3-9, 2018.

Impact of Scientific and Technological Advances

Irina Dragan,1 D. Dalessandri,2 L. Johnson,3 A. Tucker,4 and A. Walmsley5

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Advancements in research and technology are transforming our world. The dental profession is changing, too, in the light of scientific discoveries that are advancing biological technology—from new biomaterials to unravelling the genetic makeup of the human being. As health professionals, we embrace a model of continuous quality improvement and lifelong learning. Our pedagogical approach to incorporating the plethora of scientific-technological advancements calls for us to shift our paradigm from emphasis on skill acquisition to knowledge application. The 2017 ADEE/ADEA workshop provided a forum to explore and discuss strategies
to ensure that faculty, students, and, ultimately, patients are best positioned to exploit the opportunities that arise from integrating new technological advances and research outcomes. Participants discussed methods of incorporating the impact of new technologies and research findings into the education of our dental students. This report serves as a signpost of the way forward and how to promote incorporation of research and technology advances and lifelong learning into the dental education curriculum.

*Published in European Journal of Dental Education, 22:17-20, 2018.*

**U.S. Dental Schools’ Preparation for the Integrated National Board Dental Examination**

*Mai-Ly Duong, Annaliese Cothron, Nathaniel Lawson, and Eileen Doherty*

An Integrated National Board Dental Examination (INBDE) combining basic, behavioral, and clinical sciences will be implemented in 2020 to replace the current two-part National Board Dental Examination required for all candidates who seek to practice dentistry in the United States. The aims of this study were to determine how U.S. dental schools are preparing for implementation of the INBDE and to assess their top administrators’ attitudes about the new exam. A total of 150 deans, academic deans, and other administrators at all 64 U.S. dental schools with graduating classes in 2016 were emailed a 19-question electronic survey. The survey questions addressed the respondents’ level of support, perceived benefits and challenges, and planned preparation strategies for the INBDE. The individual response rate was 59%, representing 57 of the 64 schools. Approximately 60% of the respondents either agreed or strongly agreed that they support the integrated exam, while roughly 25% either somewhat or strongly disagreed. While most respondents (72%) reported that their institutions would be prepared for the INBDE, 74% reported that the merged exam created additional strain for their institutions. Respondents reported viewing content integration and clinical applicability as benefits of the INBDE, while required curriculum changes and student preparedness and stress were seen as challenges. Most of the respondents reported their schools were currently employing strategies to prepare for the INBDE, including meetings with faculty and students and changes to curricula and course content. The beginning of the fourth year and the end of the third year were the most frequently reported times when schools planned to require students to take the INBDE, although almost half of the respondents did not yet know what it would be required at their school. Several schools were reconsidering using the boards as a passing requirement. This study found that support for the INBDE was not universal, but strategies are under way to prepare students, faculty, and curricula for this new means of assessment.

*Published in Journal of Dental Education, 82(3):252-259, 2018*
Methods and Purposes for Conducting Students' Course Evaluations Reported by North American Dental School and Dental Hygiene Program Leaders: A Preliminary Survey Study

Robin Heinke,1 Tonya Enright,2 Rebecca Love,3 Shalizeh Patel4, Ala Ali,5 and Zsuzsa Horvath6

1School of Dental Medicine, University of Nevada, Las Vegas, Nevada; 2Health Science in Dental Hygiene, Allen College, Waterloo, Iowa; 3College of Dental Medicine, Roseman University of Health Sciences, South Jordan, Utah; 4University of Texas, School of Dentistry at Houston, Houston, Texas; 5Tufts University School of Dental Medicine, Boston; 6School of Dental Medicine, University of Pittsburgh, Pittsburgh, Pennsylvania

The aim of this preliminary survey study was to determine the perceptions of leaders of dental schools and dental hygiene programs regarding methods of and purposes for conducting students’ course evaluations and their role in course improvement, curriculum design, and faculty assessment. A short electronic survey was distributed in 2016 to the academic deans of all 76 dental schools in the United States and Canada and a convenience sample of program directors of 232 of the total 332 accredited dental hygiene programs. Individuals from 93 institutions responded for an overall response rate of 30%: 30 of 76 dental schools (39.5% response rate) and 63 of the 232 dental hygiene programs (27% response rate). All of the respondents (100%) reported that their institutions’ full-time faculty members were assessed by students in course evaluations for each course and semester they taught. However, only 78% reported that their part-time faculty members were evaluated by students. Course evaluations were mandatory in 62% (N=58) of the responding institutions, with the remaining 38% (N=35) optional. Respondents indicated course directors received the evaluation results for purposes of annual review (N=73, 78%) and instructional review (N=70, 75%). Further investigation of the use and effects of student evaluations is needed to better understand their role in faculty assessment and other aspects of the administration of dental schools and dental hygiene programs.


Massachusetts Dental Schools Respond to the Prescription Opioid Crisis: A Statewide Collaboration

David Keith,1,2 Ronald Kulich,2,3 Monica Bharel,4 Robert Boose,5 Jennifer Brownstein,6 John Da Silva,1 Richard D’Innocenzo,7 R. Bruce Donoff,1 Ellen Factor,5 Jeffrey Hutter,7 Jeffrey Shaefer,1 Nadeem Karimbux,3 Helen Jack,8 and Huw Thomas3

1Harvard School of Dental Medicine, Boston; 2Massachusetts General Hospital, Boston; 3Tufts University School of Dental Medicine, Boston; 4Massachusetts Department of Public Health, Boston; 5Massachusetts Dental Society, Southborough, Massachusetts; 6Harvard Vanguard Medical Associates, Cambridge, Massachusetts; 7Boston University Henry M. Goldman School of Dental Medicine, Boston; 8Harvard Medical School, Boston

The prescription opioid crisis has involved all sectors of U.S. society, affecting every community, socioeconomic group, and age group. While federal and state agencies are actively working to deal with the epidemic, medical and dental providers have been tasked to increase their awareness of the issues and consider ways to safely prescribe opioids and, at the same time, effectively treat their patients’ pain. The Commonwealth of Massachusetts, under the leadership of Governor Charles D. Baker and his administration, challenged the
state’s four medical schools and three dental schools to improve their curricula to prepare the next generation of clinicians to deal with this crisis in an evidence-based, effective, and sympathetic way. This Perspectives article outlines the national prescription opioid crisis, details its effects in Massachusetts, and describes the interdisciplinary collaboration among the Commonwealth, the three dental schools, the Massachusetts Dental Society, and a concerned student group. The article also describes the efforts each dental school is undertaking as well as an assessment of the challenges and limitations in implementing the initiative. The authors hope that the Massachusetts model will be a useful resource for dental schools in other states.


The Dental School Interview as a Predictor of Dental Students’ OSCE Performance

*Sang Park,* ¹ *Mirissa Price,* ¹ and *Nadeem Karimbux*²

¹Harvard School of Dental Medicine, Boston; ²Tufts University School of Dental Medicine, Boston

The aim of this study was to evaluate the use of the dental school admissions interview score as a noncognitive indicator of performance in predoctoral dental education, with specific attention to whether a correlation existed between the admissions interview scores and performance on the objective structured clinical examination (OSCE). The study population consisted of all 175 students in the Harvard School of Dental Medicine (HSDM) DMD Classes of 2012 through 2016. Data on students’ gender and age on entering dental school were self-reported using their applications for admission to the HSDM DMD program. Data on students’ OSCE scores for 3 examination sessions were collected from the Office of Dental Education. The results showed that the students’ interview scores did not significantly correlate with OSCE performance on any of the 3 exams. Performance on the first and second OSCEs did, however, correlate with performance on the third OSCE (p<0.05). Age on entering dental school was not significantly associated with performance on any of the 3 OSCEs; however, among male students, there was a significant negative correlation (p<0.05) between entering age and performance on the second and third OSCEs. There was no significant association between gender and OSCE or interview score. These results suggest that although the admissions interview scores can serve as an important resource in student selection, with the lack of association between interview and OSCE scores, it is possible that the communication skills required for the interview do not directly overlap with those required for OSCE success.


Impact of a Student-Driven Organization in an Academic Environment

*Farwa Rizvi,* *Tamar Roomian,* and *Irina Dragan*¹

**OBJECTIVES:** The aim of this retrospective pilot study was to evaluate the impact and success of the recently initiated Implant Study Club at Tufts University School of Dental Medicine (TUSDM). The student-driven project focused on didactic and preclinical activities organized for the student community in the academic year 2016–2017.

**METHODS:** After receiving ethical approval, this quantitative pilot study used survey instruments to collect data and assess the 4 initiatives. At the end of each event, surveys were distributed to the student body to assess the success of organized activities. The surveys were identical and the questions were either binary (yes or no) or used the Liekert Scale (poor to excellent). The questions evaluated whether the activity was helpful (question
1), provided skills and new knowledge (question 2), whether students would recommend the event to their colleagues (question 3), and whether they would be interested to join future activities (question 4). Descriptive statistics (counts and percentages for categorical items) were calculated for data analysis.

RESULTS: A total of 147 participants answered the surveys; however, some participants attended more than one initiative. Overall, a majority of participants agreed the initiatives were helpful, provided useful skills/knowledge, and were of quality. For initiative 1 (N=21) and initiative 2 (N=38), there was a 100% affirmative answer to all 5 questions. Furthermore, a majority of participants replied that they would like to attend future initiatives and would recommend the club to colleagues (for initiative 3, N=29, 96.56% answered all questions affirmatively; for initiative 4, N=59, the first 4 questions had a 98.31% affirmative response).

CONCLUSIONS: Based on the results of this pilot study, Implant Study Club at TUSDM had a beneficial impact on the student community and was a success. However, future studies with an increased sample size and a control group are needed to confirm the findings.

Presented at the 2018 AADR Annual Meeting in Fort Lauderdale, Florida. Abstract 0861.

Factors Associated with Evidence-Based Clinical Questions Presented in a Vertically Integrated Seminar Series at a U.S. Dental School

Gayathri Shenoy, Irina Dragan, Sarah Pagni, Jennipher Murphy, and Nadeem Karimbux

The Basic Science/Clinical Science Spiral Seminar Series (BaSiCsss) was implemented at Tufts University School of Dental Medicine in 2013. In the series, teams of dental students from all 4 years presented components of a clinical case, supported by evidence-based dentistry concepts. The role of the third-year student on each team was to present questions based on the population, intervention, comparison, outcome (PICO) method to support the treatment plan for the selected case. The primary aim of this study was to identify the dental discipline from which the PICO question was chosen, and the secondary aim was to review the level of evidence (journal impact factor, study design, and year of publication) of sources used to support the PICO questions. Presentations compiled during the 2014–15 and 2015–16 academic years were reviewed. The PICO questions and additional details from the publications used as reference (choice of journal, year of publication, study design) were reviewed. A total of 224 presentations were reviewed. The results showed that most topics were from the subjects of periodontology and prosthodontics. Systematic reviews and cohort studies were the most often used types of study design. The majority of the articles cited were recently published. The students used supporting references for the clinical questions published recently with a high level of evidence.


Person-Centered Care: Opportunities and Challenges for Academic Dental Institutions and Programs

Muhammad Walji,1 Nadeem Karimbux,2 and Andrew Spielman3

1University of Texas School of Dentistry at Houston, Houston, Texas; 2Tufts University School of Dental Medicine, Boston; 3New York University College of Dentistry, New York, New York

Many readers may be familiar with patient-centered care, but they may not be familiar with the concept of person-centered care. Person-centered care implies knowing the patient as a person, not as just another patient or as a clinical requirement in dental school. Person-centered care gains the trust of the patient and
is meaningful to the person because it respects their values, preferences, needs, and beliefs, emphasizing the individual's freedom of choice while promoting emotional and physical comfort. This article describes the concept of person-centered care, compares person-centered care with patient- and student-centered care, presents a vision of person-centered care in a clinic setting, discusses its opportunities and challenges in general, and outlines future topics of interest for the academic, research, and practicing dental communities, including opportunities for in-depth reviews and guidelines.

GENETICS

A Zebrafish Model of Human Fibrodysplasia Ossificans Progressiva
Melissa LaBonty, Nicholas Pray, and Pamela Yelick

Fibrodysplasia ossificans progressiva (FOP) is a rare, autosomal dominant genetic disorder in humans characterized by explosive inflammatory response to injury leading to gradual ossification within fibrous tissues, including skeletal muscle, tendons, and ligaments. A variety of animal models are needed to study and understand the etiology of human FOP. To address this need, here we present characterizations of the first adult zebrafish model for FOP. In humans, activating mutations in the Type I BMP/TGFβ family member receptor, ACVR1, are associated with FOP. Zebrafish acvr1l, previously known as alk8, is the functional ortholog of human ACVR1, and has been studied extensively in the developing zebrafish embryo, where it plays a role in early dorsoventral patterning. Constitutively active and dominant negative mutations in zebrafish acvr1l cause early lethal defects. Therefore, to study roles for activating acvr1l mutations in adult zebrafish, we created transgenic animals expressing mCherry-tagged, heat-shock-inducible constitutively active Acvr1l, Acvr1lQ204D, to investigate phenotypes in juvenile and adult zebrafish. Our studies showed that adult zebrafish expressing heat-shock-induced Acvr1lQ204D develop a number of human FOP-like phenotypes, including heterotopic ossification lesions, spinal lordosis, vertebral fusions, and malformed pelvic fins. Together, these results suggest that transgenic zebrafish expressing heat-shock-inducible Acvr1lQ204D can serve as a model for human FOP.


Colorectal Cancer-Associated Genes Are Associated with Tooth Agenesis and May Have a Role in Tooth Development
Meredith Williams,1 Claudia Biguetti,1,2 Miguel Romero-Bustillos,3 Kanwal Maheshwari,1 Nuriye Dinckan,1,4 Franco Cavalla,1,2 Xiaoming Liu,5 Renato Silva,1 Sercan Akyalcin,6 Z. Oya Uyguner,4 Alexandre Vieira,7 Brad Amendt,3 Walid Fakhouri,1 and Ariadne Letra1

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Previously reported co-occurrence of colorectal cancer (CRC) and tooth agenesis (TA) and the overlap in disease-associated gene variants suggest involvement of similar molecular pathways. Here, we took an unbiased approach and tested genome-wide significant CRC-associated variants for association with isolated TA. Thirty single nucleotide variants (SNVs) in CRC-predisposing genes/loci were genotyped in a discovery dataset composed of 440 individuals with and without isolated TA. Genome-wide significant associations were found between TA and ATF1 rs11169552 (p=4.36×10−10) and DUSP10 rs6687758 (p=1.25×10−9), and positive association found with CASC8 rs10505477 (p=8.2×10−5). Additional CRC marker haplotypes were also significantly associated with TA. Genotyping an independent dataset consisting of 52 cases with TA and 427 controls confirmed the association with CASC8. Atf1 and Dusp10 expression was detected in the mouse developing teeth from early bud stages to the formation of the complete tooth, suggesting a potential role for
Genetics

these genes and their encoded proteins in tooth development. While their individual contributions in tooth development remain to be elucidated, these genes may be considered candidates to be tested in additional populations.

Published in Scientific Reports 8(1), article number 2979, 2018.
IMPLANTOLOGY

Accuracy of Printed Casts Generated from Digital Implant Impressions vs. Stone Casts from Conventional Implant Impressions: A Comparative In Vitro Study

Bahaa Alshawaf, Hans-Peter Weber, Matthew Finkelman, Khaled El Rafie, Yukio Kudara, and Panos Papaspyridakos

OBJECTIVES: The aim of this in vitro study was to compare the accuracy of printed implant casts from digital impressions with 2 intra-oral scanners (IOS) to stone casts from conventional impressions. The hypothesis was that printed casts would be more accurate than stone casts from conventional impressions.

MATERIALS AND METHODS: A mandibular stone cast with Kennedy class II edentulism was fabricated using 2 internal connection tissue-level implants at 30 degrees to each other (Replace Select RP, Nobel Biocare) to serve as master. Digital impressions (N=10) were made with the white light (WL) and active wavefront sampling technology (AWST) IOS. The resultant standard tessellation language (STL) datasets were used to print implant casts through stereolithography (SLA) prototyping. The conventional casts (N=10) were produced with splinted open tray impression technique and polyether material in type IV stone. The master cast and all groups were digitized with lab reference scanner. The test groups STL datasets were superimposed to master cast STL in inspection software (Geomagic control 2015) to calculate root-mean-square error.

RESULTS: The conventional, WL IOS and AWST IOS groups had mean values of 53.49 μm (SD 9.47), 108.09 μm (SD 9.59) and 120.39 μm (SD 5.91), respectively. The Shapiro-Wilk test showed no evidence of nonnormality (p=0.131) and Levene’s test showed no evidence of heterogeneity of variance (p=0.518). The one-way ANOVA demonstrated a statistically significant difference (p<0.001). Tukey’s honest significant difference (HSD) showed statistically significant differences between all groups: for the comparison of AWST IOS and WL IOS, the p-value was 0.009, and the p-values of the other post hoc tests were <0.001.

CONCLUSION: Printed casts generated from digital impressions for partially edentulous posterior mandibular arches had inferior accuracy to conventional stone casts fabricated from splinted open tray impressions. The printed casts from WL IOS had better accuracy compared to AWST IOS.

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Nanomechanical Assessment of Bone Surrounding Implants Loaded for Three Years in a Canine Experimental Model

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PURPOSE: This work evaluated the nanomechanical properties of bone surrounding submerged and immediately loaded implants after 3 years in vivo. It was hypothesized that the nanomechanical properties of bone would markedly increase in immediately and functionally loaded implants compared with submerged implants.
MATERIALS AND METHODS: The second, third, and fourth right premolars and the first molar of 10 adult Doberman dogs were extracted. After 6 months, 4 implants were placed in 1 side of the mandible. The mesial implant received a cover screw and remained unloaded. The remaining 3 implants received fixed dental prostheses within 48 hours after surgery that remained in occlusal function for 3 years. After sacrifice, the bone was prepared for histologic and nanoindentation analysis. Nanoindentation was carried out under wet conditions on bone areas within the plateaus. Indentations (N=30 per histologic section) were performed with a maximum load of 300 μN (loading rate, 60 μN per second) followed by a holding and unloading time of 10 and 2 seconds, respectively. Elastic modulus (E) and hardness (H) were computed in giga-pascals. The amount of bone-to-implant contact (BIC) also was evaluated.

RESULTS: The E and H values for cortical bone regions were higher than those for trabecular bone regardless of load condition, but this difference was not statistically significant (p>0.05). The E and H values were higher for loaded implants than for submerged implants (p<0.05) for cortical and trabecular bone. For the same load condition, the E and H values for cortical and trabecular bone were not statistically different (p>0.05). The loaded and submerged implants presented BIC values (mean ± standard deviation) of 57.4±12.1% and 62±7.5%, respectively (p>0.05).

CONCLUSION: The E and H values of bone surrounding dental implants, measured by nanoindentation, were higher for immediately loaded than for submerged implants.


Narrow- and Regular-Diameter Implants in the Posterior Region of the Jaws to Support Single Crowns: A Three-Year Split-Mouth Randomized Clinical Trial

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OBJECTIVES: The objective of this 3-year split-mouth randomized controlled clinical study was to compare narrow-diameter implants (NDIs) to regular-diameter implants (RDIs) in the posterior region of the jaws (premolars and molars) in regards to (i) the marginal bone level (MBL) and (ii) implant and prosthesis survival and success rates.

MATERIAL AND METHODS: A total of 22 patients were included in the study. Each patient received at least 1 implant of each diameter [(empty set)3.3 and (empty set)4.1 mm], placed either in the maxilla or mandible to support single crowns. A total 44 implants (22 NDIs and 22 RDIs) were placed and included in the study. Twenty-one implants were placed in the premolar, whereas 23 were placed in molar areas. Radiographic evaluations to access the MBL were performed immediately after implant placement, 1 and 3 years after implant loading. Peri-implant clinical variables including probing pocket depth (PPD) and bleeding on probing (BoP) were obtained after crown delivery, 1 and 3 years after loading. Furthermore, the survival and success rates of the implants and prosthesis were also evaluated.

RESULTS: Twenty patients were able to complete the study. There was no statistically significant difference regarding MBL between groups at implant placement (p=0.084), 1-year (p=0.794) and 3-year (p=0.598) time intervals. The mean peri-implant bone loss at 3-year follow-up was −0.580.39 mm (95% CI: −0.751 to −0.409)
Implantology

and \(-0.53 \pm 0.46\) mm (95% CI: \(-0.731\) to \(-0.329\)) for NDIs and RDIs, respectively. BoP was present at 15% and 10% of NDIs and RDIs, respectively, at 3-year follow-up. PPD>5 mm was observed in 5% and 0% of the implants of NDIs and RDIs, respectively, at 3-year follow-up. At the 3-year examination, the implant success rates were in the NDIs and RDIs sites, respectively, 95% and 100%. The corresponding values for prosthesis success rates were 90% for NDIs and 95% for RDIs.

CONCLUSION: The present study demonstrated that NDIs placed to support single crowns in the posterior region did not differ to RDIs in regards to MBL, implant survival, and success rates.

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Effects of Antibiotic Prophylaxis for Lateral Window Maxillary Sinus Augmentation

Yumi Ogata, Yusuf Sheikh, Sarah Pagni,* and Yong Hur

OBJECTIVES: Lateral window sinus augmentation is indicated in patients with inadequate alveolar bone height for dental implant placement in the atrophic posterior maxilla. Although many authors suggest the use of perioperative antibiotic prophylaxis for sinus augmentation, the effect of antibiotic prophylaxis has not yet been supported by scientific evidence. The aim of this retrospective study was to evaluate the effect of antibiotic prophylaxis by examining the incidence of post-operative infection and implant failure in patients who received lateral window sinus augmentation.

METHODS: Data was gathered from the electronic health records (EHRs) of patients who received lateral window sinus augmentations from July 1, 2006, to June 30, 2017, at Tufts University School of Dental Medicine. The following information was extracted: age, sex, smoking history, prophylactic antibiotics, postoperative infection, and implant failures. Generalized estimating equations were used to reveal statistical significance in the incidence of postoperative infection and implant failure between patients with and without the use of prophylactic antibiotics. Patient- and surgery-related variables associated with infection and implant failure were also assessed. This study protocol was approved by the Tufts Health Sciences Institutional Review Board.

RESULTS: In the EHRs, 764 patients were initially identified. After exclusion of 333 patients, a total of 431 patients were included in the study. The incidence of postoperative infection was 3.25%. There was significantly less infection in patients who received antibiotic prophylaxis (2.54%) than those who did not receive antibiotic prophylaxis (10.53%) (p=0.015). With regard to the incidence of implant failure, a statistical significance (p=0.005) was found between patients who received prophylactic antibiotics before surgery (2.11%) and those who did not (12.50%).

CONCLUSIONS: Within the limitations of this study, patients requiring lateral window sinus augmentation for dental implants may benefit from the use of prophylactic antibiotics to prevent postoperative infections and implant failure.

Presented at the 2018 AADR Annual Meeting in Fort Lauderdale, Florida. Abstract 1640.
MINERALIZED TISSUE

Overexpression of MiR-335-5p Promotes Bone Formation and Regeneration in Mice

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MicroRNAs (miRNAs) and the Wnt signaling pathway play critical roles in regulating bone development and homeostasis. Our previous study revealed high expression of miR-335-5p in osteoblasts and hypertrophic chondrocytes in mouse embryos and the ability of miR-335-5p to promote osteogenic differentiation by downregulating Wnt antagonist Dickkopf-1 (DKK1). The purpose of this study was to investigate the effects of miR-335-5p constitutive overexpression on bone formation and regeneration in vivo. To that end, we generated a transgenic mouse line specifically overexpressing miR-335-5p in osteoblasts lineage by the osterix promoter and characterized its bone phenotype. Bone histomorphometry and CT analysis revealed higher bone mass and increased parameters of bone formation in transgenic mice than in wild-type littermates. Increased bone mass in transgenic mice bones also correlated with enhanced expression of osteogenic differentiation markers. Upon osteogenic induction, bone marrow stromal cells (BMSCs) isolated from transgenic mice displayed higher mRNA expression of osteogenic markers than wild-type mice BMSCs cultures. Protein expression of Runx2 and Osx was also upregulated in BMSC cultures of transgenic mice upon osteogenic induction, whereas that of DKK1 was downregulated. Most important, BMSCs from transgenic mice were able to repair craniofacial bone defects as shown by CT analysis, H&E staining, and osteocalcin (OCN) immunohistochemistry of newly formed bone in defects treated with BMSCs. Taken together, our results demonstrate constitutive overexpression of miR-335-5p driven by an osterix promoter in the osteoblast lineage induces osteogenic differentiation and bone formation in mice and support the potential application of miR-335-5p-modified BMSCs in craniofacial bone regeneration. (c) 2017 American Society for Bone and Mineral Research.

NEUROSCIENCE/TMJ/PAIN

Cross-Validation of Short Forms of the Screener and Opioid Assessment for Patients with Pain-Revised (SOAPP-R)

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BACKGROUND: The Screener and Opioid Assessment for Patients with Pain-Revised (SOAPP-R) is a 24-item assessment designed to assist in the prediction of aberrant drug-related behavior (ADB) among patients with chronic pain. Recent work has created shorter versions of the SOAPP-R, including a static 12-item short form and 2 computer-based methods (curtailment and stochastic curtailment) that monitor assessments in progress. The purpose of this study was to cross-validate these shorter versions in 2 new populations.

METHODS: This retrospective study used data from patients recruited from a hospital-based pain center (N=84) and pain patients followed and treated at primary care centers (N=110). Subjects had been administered the SOAPP-R and assessed for ADB. In real-data simulation, the sensitivity, specificity, and area under the curve (AUC) of each form were calculated, as was the mean test length using curtailment and stochastic curtailment.

RESULTS: Curtailment reduced the number of items administered by 30% to 34% while maintaining sensitivity and specificity identical to those of the full-length SOAPP-R. Stochastic curtailment reduced the number of items administered by 45% to 63% while maintaining sensitivity and specificity within 0.03 of those of the full-length SOAPP-R. The AUC of the 12-item form was equal to that of the 24-item form in both populations.

CONCLUSIONS: Curtailment, stochastic curtailment, and the 12-item short form have potential to enhance the efficiency of the SOAPP-R.

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Persistent Dentoalveolar Pain Disorder: A Comprehensive Review

Alberto Malacarne, Egilius Spierings, Chao Lu, and George Maloney

INTRODUCTION: Persistent dentoalveolar pain of idiopathic origin represents a diagnostic challenge for the dentist and physician alike. Disagreement on taxonomy and diagnostic criteria presents a significant limit to the advancement of research in the field. Patients struggle with a lack of knowledge by dental and medical professionals, diagnostic delays, and unnecessary treatments.

METHODS: A PubMed search was performed as of January 1, 2017, by using the terms atypical odontalgia, phantom tooth pain, persistent idiopathic facial pain, painful posttraumatic trigeminal neuropathy, idiopathic toothache, persistent dentoalveolar pain disorder, nonodontogenic tooth pain, and continuous neuropathic orofacial pain. Three hundred forty-five abstracts were screened, and 128 articles that were pertinent to the topic went through full-text reading.

RESULTS: Case reports and narrative reviews constitute the majority of available literature. Several retrospective case-control studies investigated the clinical characteristics, pathophysiology, and diagnostic processes. Treatment strategies were evaluated in only 7 open-label and 2 randomized controlled trials.
CONCLUSIONS: Persistent dentoalveolar pain disorder is likely neuropathic in origin, but pathophysiological mechanisms to explain the onset and persistence of the pain are still far from understood. A correct diagnosis should be established before treatments are performed. Researchers should reach an agreement on the diagnostic criteria to enable a coherent research path to better understand the condition and reduce patient suffering.


Efficacy and Safety of Lubiprostone in Patients with Opioid-Induced Constipation: Phase 3 Study Results and Pooled Analysis of the Effect of Concomitant Methadone Use on Clinical Outcomes

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OBJECTIVE: The efficacy and safety of oral lubiprostone for relieving symptoms of opioid-induced constipation (OIC) in patients with chronic noncancer pain were evaluated in a randomized, double-blind, placebo-controlled study. These data were also pooled with those from 2 similar phase 3 studies to explore the effects of methadone on treatment response.

METHODS: In the primary study, adults with OIC (fewer than 3 spontaneous bowel movements [SBMs] per week) were randomized to receive lubiprostone 24mcg or placebo twice daily for 12 weeks. The primary endpoint was a change from baseline in the frequency of SBMs at week 8 in patients without a prior dose reduction. For the pooled analysis, the efficacy of lubiprostone was compared with placebo in patients receiving methadone or nonmethadone opioids. Responders were defined as patients with 9 or more weeks of nonmissing SBM data who had 1 or more additional SBMs per week from baseline for each week that data were available and 3 or more SBMs per week for 9 or more weeks.

RESULTS: In the primary study, the change from baseline at week 8 in SBM frequency was similar in the lubiprostone and placebo groups (p=0.842). In the pooled analysis, the response rate was significantly higher with lubiprostone treatment vs. placebo for patients receiving nonmethadone opioids (p=0.002) but was similar between lubiprostone treatment and placebo in patients receiving methadone (p=0.692). The safety profile of lubiprostone was unaffected by methadone use.

CONCLUSIONS: The phase 3 study did not meet its primary efficacy end point. However, analysis of pooled data from all phase 3 studies in the OIC clinical development program, stratified by methadone opioid usage, confirmed that lubiprostone is effective for treatment of OIC in patients taking nonmethadone opioids; no safety concerns were identified based on the type of opioid used.

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Mouse Model Demonstrates Strain Differences in Susceptibility to Opioid Side Effects

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Individual differences have been observed in responses to opioid drugs, including common side effects. In this study, the inbred mouse strains A/J and C57BL/6J were used to determine whether their specific strain differences correlate with differences in susceptibility to respiratory depression and constipation. To measure the effects of morphine on respiration, morphine at 15 and 40 mg/kg was injected subcutaneously. Respiratory parameters were then measured 30 and 60 min later. To measure the effects on constipation, 5, 15, 40, and 60 mg/kg doses were administered subcutaneously 3 times daily for 3 days. Gastrointestinal transit distance was then measured using the charcoal bolus test. C57BL/6J mice showed a greater degree of change in several respiratory parameters, resulting in more pronounced respiratory depression. C57BL6J mice also showed significantly more constipation than A/J mice with 40 and 60 mg/kg morphine doses. This study demonstrates that the strain differences between A/J and C57BL/6J mice have a major effect on opioid-induced constipation and respiratory depression. These correlations are of great clinical interest, as they could lead to the development of methods for reducing side effects.

ORAL HEALTH RESEARCH

Dental Care as a Safe and Essential Part of a Healthy Pregnancy

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Oral health is essential for general health and well-being, and this is especially so during pregnancy. Pregnancy may present challenges to the oral health of the mother, mainly because of adaptations in basic physiology. However, many mothers-to-be and their health professionals, both prenatal and dental, are unsure as to the safety of providing dental care during pregnancy. National guidelines, together with recommendations from numerous state-level and professional organizations, consistently indicate that provision of dental care is both safe and essential during pregnancy. Pregnancy also provides opportunities for the oral health of both infant and new mother after delivery that can set the infant on a lifetime pathway that minimizes preventable oral disease. This review summarizes guidelines for dental care during pregnancy, provides an overview of physiologic changes that occur and their relevance to oral health and dental care delivery, outlines risk factors for oral conditions, and considers timely preventive strategies. It also underscores the need for interprofessional collaboration with the perinatal team to optimize the quality of healthcare and ensure positive outcomes.

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Factors Affecting Clinical Research Participation at the Tufts Dental School

James Kirchmeyer,*, Amanda Gozzi, Tamar Roomian, Gerard Kugel, Elizabeth Tzavaras, and Pamela Corrado

OBJECTIVES: Clinical research at Tufts University School of Dental Medicine (TUSDM) is dedicated to the advancement of science and improving oral health care. Research participation is critical to achieving these goals. In reviewing 7 clinical research studies conducted at TUSDM from 2014 to 2016, a participant retention rate of 96% was achieved. This study sought to identify factors affecting research recruitment and retention at TUSDM through quantitative methods.

METHODS: An Institutional Review Board approved, 33-question, validated survey using Likert scaling was administered through Qualtrics to 27 enrolled research participants attending a final study visit at the TUSDM research clinic. Survey questions evaluated reasons for participation and the level of satisfaction with the TUSDM research experience. Fisher’s exact test was used to determine associations.

RESULTS: Of the 27 participants surveyed, 74% were between the ages of 21 and 50. The majority of participants were female (78%); 59% identified as white, non-Hispanic. English was the language most commonly spoken at home (78%); 52% of participants were employed. Compensation was considered “very important” to 41% of participants, while a positive experience with the dentist and coordinators was considered “very important” by 67% and 70% respectively. Recruitment by word of mouth was not associated with returning 2 or more times (p=1.00); however, recruitment by phone call was associated with increased retention (p=0.02). A majority of participants (81%) rated their overall experience as “excellent,” and 100% reported a willingness to come back to TUSDM for research based on their experience.
CONCLUSIONS: A positive research experience between research team members and participants, along with compensation considerations, may increase retention rates for current studies and recruitment rates for future research studies. There appears to be a correlation between informing potential participants of a research study directly over the phone and getting them to return for future research participation.

Presented at the 2018 AADR Annual Meeting in Fort Lauderdale, Florida. Abstract 1680.
ORAL AND MAXILLOFACIAL SURGERY

Bone Resorption during Submerged Healing after Guided Bone Regeneration: A Prospective Case Series
Yong Hur, Yumi Ogata, Douglas Kim, Charles Pham, Tae-Ho Yoon, and Hirokazu Ogata

OBJECTIVE: The aim of this study was to evaluate bone resorption quantitatively during the healing period subsequent to ridge augmentation.

MATERIALS AND METHODS: Sixteen patients requiring vertical ridge augmentation before implant placement were recruited in the study. The study used an allograft and non-resorbable membrane. A custom acrylic stent was used to measure changes in bone volume. Augmented bone was compared with remaining bone 6 months after guided bone regeneration (alpha=0.05 by means of the paired t-test).

RESULTS: All sites following the 6 months post-surgery were analyzed. Overall changes in alveolar bone were observed with a mean resorption rate of 19.8% (p< 0.001). The vertical bone measurement indicated a mean resorption rate of 22.8% (range: 18.5–26.5%). The horizontal measurement indicated a mean resorption rate of 18.7% (range: 12.6–26.0%). Among the 16 sites, 4 sites with postoperative complications including membrane exposure showed an average of 42.1% resorption rates.

CONCLUSION: Loss in graft quantity was observed after ridge augmentation using an allograft and nonresorbable membrane during submerged healing before implant placement. Further studies with larger sample sizes are recommended to confirm its findings.

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Anatomical Variations of PSAA Related to Sinus Augmentation: CBCT Analysis
Nari Park,* Yong Hur, Sarah Pagni, and Yumi Ogata

OBJECTIVES: Accidental severing of maxillary sinus vasculature, particularly the posterior superior alveolar artery (PSAA), is a common intraoperative complication during lateral sinus augmentation. The hemorrhage may impair surgical field visualization, potentially leading to Schneiderian membrane perforation, the most common surgical complication of the procedure. The aims of this retrospective study were: (1) to assess the prevalence, diameter, and location of the PSAA related to lateral sinus augmentation and (2) to investigate possible associations between anatomical variations of the PSAA and membrane perforations.

METHODS: Patients who received lateral sinus augmentation at Tufts University School of Dental Medicine from July 1, 2006, to June 30, 2017, with pre-operative cone-beam computed tomography (CBCT) images were included in this study. The CBCT images were analyzed to evaluate possible associations between prevalence of the PSAA, diameter of the PSAA, location of the PSAA, distance of the PSAA from the alveolar crest, distance of the PSAA from the sinus floor, residual bone height, and Schneiderian membrane perforation. Statistical analysis was performed using the independent samples t-test and Wilcoxon rank sum test at p<0.05 level.

RESULTS: A total of 204 patients were included in the study. Of these, 64 patients (31.37%) had membrane perforation. The PSAA was prevalent in 62.75% of the sinuses on CBCT images and the most frequent location of PSAA was intraosseous (57.0%). Variations in anatomical factors of the PSAA and residual bone height were
compared between perforation and nonperforation groups (Table 1). There were no statistically significant
differences in prevalence of PSAA, diameter of PSAA, distance of PSAA from the alveolar crest, distance of
PSAA from the sinus floor, and residual bone height between the perforation and non-perforation groups.

**Table 1:** Anatomical variations of the PSAA and residual bone height

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Perforation</th>
<th>Non-Perforation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean prevalence of PSAA, n(%)</td>
<td>64 (31.37)</td>
<td>140 (64)</td>
</tr>
<tr>
<td>Median prevalence of PSAA, (mm)</td>
<td>1.08±0.38</td>
<td>1.17±0.44</td>
</tr>
<tr>
<td>Mean distance of PSAA from alveolar crest (mm)</td>
<td>13.98±5.75</td>
<td>14.31±4.90</td>
</tr>
<tr>
<td>Mean distance of PSAA from sinus floor (mm)</td>
<td>9.91±5.74</td>
<td>9.68±4.78</td>
</tr>
<tr>
<td>Mean residual bone height (mm)</td>
<td>4.00±1.68</td>
<td>4.55±2.21</td>
</tr>
</tbody>
</table>

**CONCLUSIONS:** Within the limitations of this study, there were no associations between certain anatomical
variations of the PSAA and membrane perforation during lateral sinus augmentation.

*Presented at the 2018 AADR Annual Meeting in Fort Lauderdale, Florida. Abstract #1639.*

**Surgical Safety Checklists Are Underutilized in Ambulatory Oral and Maxillofacial Surgery**

*Archana Viswanath, Andras Balint, Robert Johnson III, Morton Rosenberg, and Daniel Oreadi*

**PURPOSE:** The objective of this study was to determine attitudes toward and the prevalence of using a surgical
safety checklist in ambulatory oral and maxillofacial surgery (OMS) practice.

**MATERIALS AND METHODS:** The authors designed and implemented a cross-sectional study and enrolled
a random sample of oral and maxillofacial surgeons. The predictor variable was years removed from residency.
The primary outcome was the prevalence of surgical safety checklist usage in ambulatory OMS practice. The
secondary outcome was to determine whether surgeons who do not currently use a checklist would be willing
to do so if provided with one. Other demographic variables included age, gender, location of practice, type of
practice, and number of ambulatory procedures performed per week. Appropriate uni- and bivariate statistics
were computed and the level of significance set at 0.05; 95% confidence intervals also were calculated.

**RESULTS:** The study sample was composed of 120 clinicians. Forty-two percent of respondents reported that
they were not using a surgical safety checklist for ambulatory surgery. Ninety-three percent of those respondents
not currently using a checklist reported they would consider implementing a surgical safety checklist in their
practice if provided with one. In addition, 45.3% of surgeons performing more than 30 procedures a week
reported not using a surgical safety checklist. Most respondents (67.9%) who had completed OMS training more
than 20 years previously reported not using a checklist in their practice.

**CONCLUSION:** According to this survey, most practicing oral and maxillofacial surgeons do not currently use
surgical safety checklists. Although the response rate was only 12%, the survey does reflect a clear lack of use of
checklists among practicing oral and maxillofacial surgeons despite its widespread acceptance in the medical
community.

ORAL MEDICINE AND PATHOLOGY RESEARCH

RNA-Seq Analysis of Different Expressions in White Sponge Nevus
Zhekai Hu* and Jake Chen

OBJECTIVES: Increasingly, people have begun to take oral disease prevention and treatment seriously nowadays. However, in reality, there are some oral diseases that have not been fully appreciated valued by doctors and patients because of their unusual causes and low incidences. In this study, we explore the changes in the disease tissues and discover meaningful pathways and correlative networks to provide some references for future researches and treatments.

METHODS: Two samples from a diseased area and 2 samples from an adjacent area were collected from Shandong University School of Stomatology, China. Using the methods of RNA-sequencing and tissue sections, we assessed the phenotypes and mechanisms inside this disease.

RESULTS: From the results, we identified 7 single nucleotide polymorphisms (SNPs) in KRT6B, KRT14, and KRT16 genes, which were related to tissue keratinization. Further, in the level of mRNA, we found that 4 keratinization-related genes showed hundreds of folds high-expressions in diseases tissues. Then, in KEGG analysis, we found that many pathways showed the different expressions and the pathways of systemic lupus erythematosus and alcoholism were highlighted, which showed the highest enrichments and correlations in this disease. More specifically, in GO analysis, we generalized all biological processes into 9 major parts such as mononuclear cell migration, cornification, and angiogenesis. With further studies in RNA interactions, we analyzed some major correlations between miRNA and mRNA.

CONCLUSIONS: Consistent with previous studies, important mutants were discovered in keratinization-related genes and high expression was also found in these genes. Surprisingly, however, in the level of interactions between RNAs, we found a new unique axis from circRNAs, miRNAs, and mRNAs and in the level of pathways, we found SLE-related pathways were highly expressing, and we found that those might imply this disease was correlated with immune diversities and keratinization.

Presented at the 2018 AADR Annual Meeting in Fort Lauderdale, Florida. Abstract 0359.

HPV-16 in a Distinct Subset of Oral Epithelial Dysplasia
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Human papillomavirus (HPV) 16 is the most common high-risk HPV type identified in oropharyngeal and cervical neoplasia. Recently, HPV-associated oral epithelial dysplasia with specific histopathologic features and demographics similar to HPV-oropharyngeal carcinoma has been identified. The objective of this study was to evaluate histopathologically all cases of HPV-oral epithelial dysplasia seen in one center and identify HPV types in a subset of cases. Cases with specific histopathology for HPV-oral epithelial dysplasia that were positive both by immunohistochemical studies for p16 and by in situ hybridization for high-risk types of HPV were further
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analyzed using QIAamp DNA Tissue Kits (Qiagen, Hilden, Germany). DNA was extracted, amplified, and digested with restriction enzymes and run on a polyacrylamide gel. Digestion patterns were visually compared with a database of known HPV digestion patterns for identification. There were 53 specimens included in the analysis. There were 47 males and 6 females (7.8:1), with a median age of 55 years (range: 41–81). The most common site of involvement was the tongue/floor of mouth (77% of cases). Of the 53 cases, 94% exhibited parakeratosis and/or hyperkeratosis. All the cases featured karyorrhexis, apoptosis, and characteristics of conventional carcinoma in situ. The quantity of DNA extracted was sufficient for analysis in 22 cases. HPV-16 was identified in 20/22 (91%) cases. One case was associated with HPV-33 and one with HPV-58 (5% each). Eight of the 53 cases (15%) were associated with invasive squamous cell carcinomas.

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**Immunohistopathological Characterization and the Impact of Topical Immunomodulatory Therapy in Oral Chronic Graft-vs.-Host Disease: A Pilot Study**

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**OBJECTIVE:** To characterize the immunohistopathological features of oral chronic graft-vs.-host disease (cGVHD), and the impact of topical immunomodulatory therapy on the infiltrating cells.

**MATERIAL AND METHODS:** Paired oral cGVHD biopsies obtained before (N=12) and 1 month after treatment (N=12) with topical dexamethasone (N=8) or tacrolimus (N=4) were characterized by immunohistochemistry using a panel of CD1a, CD3, CD4, CD8, CD20, CD31, CD62E, CD103, CD163, c-kit, and FoxP3. Controls included acute GVHD (aGVHD; N=3), oral lichen planus (OLP; N=5), and normal tissues (N=5).

**RESULTS:** Oral cGVHD specimens prior to treatment were mainly characterized by basal cell squamatization, lichenoid inflammation, sclerosis, apoptosis, and lymphocytic exocytosis. The infiltrating cells in oral cGVHD primarily consisted of CD3+, CD4+, CD8+, CD103+, CD163+, and FoxP3+ cells, which were higher than in normal tissues. Topical dexamethasone or tacrolimus reduced neutrophilic exocytosis, basal cell squamatization, and lichenoid inflammation in oral cGVHD, and dexamethasone reduced the number of CD4+ and CD103+ cells.

**CONCLUSION:** The high expression of CD3, CD4, CD8, CD103, CD163, and FoxP3 confirms that oral cGVHD is largely T-cell-driven with macrophage participation. The impact of topical immunomodulatory therapy was variable, reducing histological inflammatory features, but with a weak clinicopathological correlation. Topical dexamethasone reduced the expression of CD4 and CD103, which may offer novel therapeutic targets.

Oral Cancer Screening Usage in Undergraduate Clinics at Tufts Dental

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OBJECTIVES: To assess the knowledge and confidence of undergraduate dental students at Tufts University School of Dental Medicine (TUSDM) in clinically identifying OC. Though oral cancer (OC) frequently remains undiagnosed until later stages, where the 5-year survival rate is as low as 30%, this may be improved through careful screening of the oral cavity.

METHODS: All incoming fourth-year TUSDM dental students (N=210) were asked to complete a survey via Qualtrics assessing accuracy in diagnosing OC based on a clinical photo and comfort when interpreting biopsy reports and treatment planning for OC patients. Students were asked if they have examined patients with diagnosed OC at TUSDM and if they would like more information about OC built into the TUSDM curriculum. Data from the experiment was analyzed using the chi-squared test (or Fisher’s exact test, if sparse expected cell counts), where p<0.05 is significant.

RESULTS: Of the 54 responses, all participants routinely examined the oral mucosa of every patient and knew where malignant OC lesions are most often found. Of the participants, 73% (35/54) felt that they have sufficient knowledge to identify patients at risk for OC and to identify potentially malignant lesions. However, only 22% (12/54) of students correctly diagnosed 1 pictured lesion. When asked about familiarity with biopsy reports and taking appropriate follow-up action, 58% (28/54) of students rated themselves as uncomfortable. Of those surveyed, only 31% (15/54) have had the opportunity to examine patients with OC at TUSDM. When participants were asked if they would like more pathology information added to the curriculum at TUSDM, 88% wanted additional lectures or online materials.

CONCLUSIONS: Though fourth-year students at TUSDM reportedly feel comfortable identifying oral lesions, many still would like additional information regarding OC diagnosis, biopsy reporting, and treatment plans.

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Epulis Fissuratum: Comparison of Clinical Impression to Histopathologic Diagnosis

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OBJECTIVE: This study evaluated the percentage of cases correctly identified as epulis fissuratum based on the clinical impression and histopathologic diagnosis and evaluated the percentage of cases identified as a malignancy by the histopathologic diagnosis with a clinical impression of epulis fissuratum.

FINDINGS: A search in the database systems at the biopsy services of University of Nebraska Medical Center College of Dentistry and Tufts University School of Dental Medicine for the clinical impression term epulis/epulis fissuratum from January 1, 2012, until July 1, 2017, was performed, which identified 187 cases. The Fisher’s exact test measured the similarity between dental practitioners’ clinical impression of epulis fissuratum and histopathologic findings. Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of the dental practitioners’ clinical impression about the malignancy of epulis fissuratum were calculated. P-value<0.05 was considered statistically significant. From the 187 cases, there was a female
predilection (67%), more than half of the cases (55%) were in the maxillary region (palate, vestibule), and patients wearing ill-fitting dentures were identified at 60%. Seven cases (3%) were identified as malignant by the histopathologic diagnosis, which included squamous cell carcinoma and melanoma, but malignancy was not suspected in 2 of the 7 cases. Epulis fissuratum was listed as the only clinical impression. More than half of the cases (54%) were correctly identified as epulis fissuratum based on the clinical impression and histopathologic diagnosis.

**CONCLUSION:** Based on the collected data, dental practitioners should remove and submit excised tissue for microscopic analysis to rule out malignancy in suspected cases of epulis fissuratum.

*Presented at the Joint IAOP-AAOMP Meeting in Vancouver, California.*
ORTHODONTICS RESEARCH

Accuracy of Three-Dimensional Curvilinear Measurements on Digital Models with Intraoral Scanners

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INTRODUCTION: Our objectives were to evaluate and compare the digital dental models generated from 2 commercial intraoral scanners with manual measurements when performing 3D surface measurements along a curved line (curvilinear).

METHODS: Dry mandibles (N=61) with intact dentition were used. The mandibles were digitized using 2 chair-side intraoral scanners: Cadent iTero (Align Technology, San Jose, California) and Lythos Digital Impression system (Ormco, Orange, California). Digitized 3D models were converted to individual stereolithography files and used with commercial software to obtain the curvilinear measurements. Manual measurements were carried out directly on the mandibular teeth. Measurements were made on different locations on the dental arch in various directions. One-sample t-tests and linear regression analyses were performed. To further graphically examine the accuracy between the different methods, Bland-Altman plots were computed. The level of significance was set at p<0.05.

RESULTS: There were no significant differences between any of the paired methods; this indicated a certain level of agreement between the methods tested (p>0.05). Bland-Altman analysis showed no fixed bias of one approach vs. the other, and random errors were detected in all comparisons. Although the mean biases of the digital models obtained by the iTero and Lythos scanners, when compared with direct caliper measurements, were low, the comparison of the 2 intraoral scanners yielded the lowest mean bias. No comparison displayed statistical significance for the t scores; this indicated the absence of proportional bias in these comparisons.

CONCLUSIONS: The intraoral scanners tested in this study produced digital dental models that were comparatively accurate when performing direct surface measurements along a curved line in 3 dimensions.
**PEDIATRIC DENTISTRY RESEARCH**

**Radiographic Effectiveness of Resin Infiltration in Arresting Incipient Proximal Enamel Lesions in Primary Molars**

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**PURPOSE:** The purpose of this split-mouth, randomized, prospective clinical trial was to evaluate radiographically the effectiveness of resin infiltration, as an adjunct to standard-of-care preventive measures compared to standard-of-care preventive measures alone, in arresting the progression of non-adjacent, incipient, proximal enamel lesions in primary molars 24 months after treatment.

**METHODS:** The study included a total of 45 healthy 5- to 8-year-olds who had been diagnosed radiographically with at least 2 non-adjacent, incipient, proximal enamel lesions in primary molars (90 lesions). Test group lesions were treated using resin infiltration followed by 5% topical sodium fluoride (NaF) application vs. 5% NaF alone in the control group. The alpha level was set at 0.05.

**RESULTS:** The children were examined after 6, 12, 18, and 24 months. Twenty-five subjects were examined at the 24-month follow-up visit, at which time 10 of the 25 test lesions (40%) showed caries progression while 18 of the 25 control lesions (72%) showed caries progression (p=0.04).

**CONCLUSION:** Resin infiltration as an adjunct to standard-of-care preventive measures is significantly more effective radiographically in reducing the progression of non-adjacent, incipient, proximal enamel lesions in primary molars compared with standard-of-care preventive measures alone after 24 months.

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**Regional Odontodysplasia Crossing the Midline**

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Regional odontodysplasia is a non-hereditary development dental anomaly involving epithelial and mesenchymal-derived dental tissues. The condition affects both primary and permanent teeth. Clinically, affected teeth are hypoplastic, soft upon probing, have a yellow-brown discoloration, and present high susceptibility to caries. Radiographically, the teeth show enlarged pulp chambers, open apices, and no clear differentiation between enamel and dentin. The reduced radiopacity of the enamel and dentin gave rise to the term “ghost teeth.” We present the case of a 3-year-old boy diagnosed with regional odontodysplasia involving more than one quadrant, showing facial asymmetry and missing primary and permanent teeth.

Effectiveness of an Oral Health Education Program for Obstetrician/Gynecologist Residents at Tufts Medical Center

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AIM AND OBJECTIVES: To assess Tufts Medical Center obstetrician/gynecologist (OB/GYN) residents’ knowledge, beliefs, and previous training in oral health and to assess the effect of an oral health educational seminar on their knowledge and beliefs.

MATERIALS AND METHODS: A preseminar questionnaire was distributed to the residents. The same questionnaire was distributed immediately after the seminar and 3 months later. SPSS Version 21 was used for the data analysis.

RESULTS: Convenience sample of 25 residents were included in the study. The mean (standard deviation) age of participants was 29.08 (2.47) years. Only 1 (4%) participant reported receiving >8 h previous training in oral health and 7 (28%) reported receiving <1 h of training. The nonparametric Friedman test showed a statistically significant difference between administrations in terms of total score on knowledge-based questions (p<0.001) and some of the belief-based questions. The post hoc Wilcoxon signed-rank test with Bonferroni correction showed statistically significant improvement in the knowledge-based questions between pre- and postseminar questionnaire (p=0.002) and between preseminar and 3-month follow-up (p=0.003).

CONCLUSIONS: OB/GYN residents at Tufts Medical Center received limited training in oral health. Their knowledge improved significantly following the oral health educational seminar. Similar training modules can be brought to other OB/GYN residencies and OB/GYNs in an effort to enhance the symbiotic relationship between medical and dental professionals.

PERIODONTOLOGY RESEARCH

Prospective Study of the Impact of Peri-implant Soft Tissue Properties on Patient-Reported and Clinically Assessed Outcomes

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BACKGROUND: It has been proposed that the presence of a zone of keratinized mucosa (KM) around implants is associated with less discomfort during brushing and improved esthetic outcomes. Therefore, mucogingival procedures have been recommended for patients with discomfort during brushing and to enhance esthetic results around implants without KM. However, no study has systematically assessed and compared discomfort during brushing, patient soft tissue esthetic satisfaction, and other clinical parameters between implants with and without KM.

METHODS: Group 1 included patients with implants surrounded by KM, whereas patients in group 2 had no KM around implants. Patient discomfort during brushing and esthetic satisfaction were measured with a visual analogue scale and compared between the 2 groups using a mixed model. Clinical width of KM, probing depth, peri-implant recession, plaque index, and bleeding on probing were compared within and between groups 3 and 6 months following implant restoration.

RESULTS: Twenty-four patients (12 in each group) were evaluated at the 3- and 6-month follow-up visits. Patients without peri-implant KM were less satisfied with the esthetics of the soft tissue around their implants (p<0.01). However, lack of KM was not associated with discomfort during brushing. In group 1, width of KM was significantly increased after 6 months (p<0.01). There was greater recession around implants without KM after 3 months (p<0.01), but not after 6 months.

CONCLUSIONS: Patients reported that presence or absence of keratinized mucosa did not affect discomfort associated with brushing. Yet, esthetically, patients preferred implants with a zone of keratinized mucosa.

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Clinical Outcomes of Comparing Soft Tissue Alternatives to Free Gingival Graft: A Systematic Review and Meta-analysis

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OBJECTIVES: This systematic review and meta-analysis aimed to compare clinical outcomes and width of keratinized tissue (KT) around teeth, following the soft tissue alternatives and free gingival graft (FGG) procedures. The specific graft materials that were explored were extracellular matrix membrane, bilayer collagen membrane, living cellular construct, and acellular dermal matrix.

METHODS: Four different databases were queried to identify human controlled clinical trials and randomized controlled clinical trials that fulfilled the eligibility criteria. Relevant studies were identified by 3 independent
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reviewers, compiling the results of the electronic and hand searches. Studies identified through electronic and hand searches were reviewed by title, abstract, and full text using Covidence Software. Primary outcome in the present study was change in the width of KT. Results of the included studies were pooled to estimate the effect size, expressed as weighted mean differences and 95% confidence interval. A random-effects model was used to perform the meta-analyses.

RESULTS: In the study, 638 articles were screened by title, 55 articles were screened by abstracts, and 34 full-text articles were reviewed. Data on quantitative changes in width of KT were provided in 7 studies. Quantitative analyses revealed a significant difference in changes in width of KT between patients treated with soft tissue alternatives and patients treated with FGGs (p<0.001). The weighted mean difference of changes in the width of KT was 21.39 (95% confidence interval: 21.82 to 20.96; heterogeneity I² 70.89%), indicating patients who were treated with soft tissue alternatives gained 1.39 mm less KT width compared with the patients who received free gingival graft.

CONCLUSIONS: Based on the clinical outcomes, the results of this systematic review and meta-analysis showed that soft tissue alternatives result in an increased width of KT. Patients in the soft tissue alternatives group obtained 1.39 mm less KT compared with those in the FGGs group.

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Different Flap Designs Have No Impact on Periodontal Outcomes on Second Molars after Impacted Third-Molar Extraction

Yong Hur and Yumi Ogata

SYSTEMATIC REVIEW CONCLUSION: The different surgical flap designs for mandibular third-molar extraction did not have a significantly different impact on postoperative periodontal outcomes of the mandibular second molars with a minimum follow-up period of 3 months.

CRITICAL SUMMARY ASSESSMENT: This systematic review with limited evidence indicated there is no compelling reason to support the use of a particular flap design for impacted mandibular third-molar extraction.

EVIDENCE QUALITY RATING: Limited.


The Root Coverage Esthetic Score: Intra-examiner Reliability among Dental Students and Dental Faculty

Federica Isaia, Robert Gyurko, Tamar Roomian, and Charles Hawley

BACKGROUND: The root coverage esthetic score (RES) was published in 2009 as an esthetic scoring system to measure visible final outcomes of root coverage procedures performed on Miller I and II recession defects. The aim of this study was to evaluate the intra-examiner, intra-group, and inter-examiner reliability of the RES when used among periodontal faculty, postgraduate students in periodontology, and predoctoral DMD students when using the RES at Tufts University School of Dental Medicine (TUSDM).

METHODS: Thirty-three participants (12 second-year DMD students, 11 periodontal residents, and 10 faculty members) were assembled to evaluate 25 baseline and 6-month posttreatment outcomes of mucogingival
surgeries using the RES. Each projection was shown for 30 seconds during which the participants were asked to use the RES scoring system to evaluate the surgical outcomes. The results were then recorded on a standardized worksheet grid. To test intra-examiner reliability, 7 of the 25 projections were shown twice. Intra-examiner reliability and inter-examiner reliability were assessed using intraclass correlation coefficient using a two-way mixed effect model, and stratified by education level.

**RESULTS:** Postgraduate (PG) residents had the highest tendency to agree with each other with an interclass correlation (ICC) of 0.53 (95% confidence interval [CI]: 0.36 to 0.74). DMD students had an ICC of 0.51 (95% CI: 0.33 to 0.75), and PG faculty members produced an ICC of 0.41 (95% CI: 0.24 to 0.64). There was no statistically significant difference in ICC among the 3 groups of participants (Kruskal-Wallis test, \( p=0.2440 \)). When the data for each RES element were then combined, the mean ICC for the total inter-rater agreement for RES was 0.48 (95% CI: 0.32 to 0.71). This corresponds to an overall moderate agreement among all participants using the RES to evaluate the 25 surgical outcomes. The intra-examiner reliability within each of the 3 groups was quite high. The highest mean ICC was produced by PG faculty (0.908). The mean ICCs for PG residents was 0.867, and the mean ICC for DMD students was 0.855. The Kruskal-Wallis test (\( p=0.46 \)) failed to find any statistical difference in intra-examiner reliability among the 3 groups of participants.

**CONCLUSIONS:** The RES is a moderately reliable scoring system for mucogingival treatments in a dental school setting and can be used even by operators with different levels of periodontal experience. This scoring system can be repeated by the same examiner to obtain reliable results.

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**Comparison of Complications and Patient-Reported Outcomes between Lateral and Transcrestal Sinus Augmentation with Simultaneous Implant Placement: A Randomized Controlled Clinical Trial**

**Won Kim, Irina Dragan, Yong Hur, Yumi Ogata, and Hans-Peter Weber**

**BACKGROUND:** Lateral window and transcrestal techniques for sinus augmentation have been used predictably to rehabilitate posterior maxilla. However, current literature does not provide evidence-based criteria for selecting 1 of the 2 techniques when residual bone height is limited between 4 and 6 mm. Furthermore, a direct comparison between 2 techniques regarding the complications and patient-reported outcomes (PROs) has not yet been published. The goals of this study were to (1) compare the incidence of Schneiderian membrane perforation, (2) compare PROs during surgery and over a 1-week postoperative period, and (3) evaluate postoperative complications between 2 techniques.

**METHODS:** The study was designed as a single-blind, parallel-group, randomized controlled clinical trial. Forty patients with residual bone height between 4 and 6 mm were randomly assigned to either lateral window or transcrestal sinus augmentation technique. A piezoelectric device was used to gain access to the sinus for both approaches. Deproteinized bovine bone mineral (DBBM) (Bio-Oss®), collagen membrane (Bio-Gide®), and the same type of implant (Straumann TE 4.1 × 10 mm) were used. Intraoperative complications were recorded during surgery. PROs on intraoperative discomfort and postoperative experiences (pain, bleeding, and swelling) using visual analogue scale (VAS) were obtained immediately after surgery and at 1-week follow-up, respectively. The number of pain medications was recorded at 1-week follow-up. Postoperative complications were evaluated at 1-, 4-, and 12-week follow-ups. This study was conducted in accordance with the Consolidated Standards of Reporting Trials (CONSORT) Statement.
RESULTS: The incidence of Schneiderian membrane perforation was higher in lateral window technique than transcrestal technique (35% and 15%, respectively), but the difference was not statistically significant (p=0.273). The transcrestal technique had significantly less discomfort during the surgery than the lateral window technique (1.0 and 3.0, respectively, p=0.004). No statistically significant differences were found for postoperative pain and bleeding. However, there was a statistically significant difference for postoperative swelling, higher in lateral window than transcrestal technique (4.0 and 1.0, respectively, p<0.001). There were no statistically significant differences in the incidence of postoperative complications and the number of pain medications between the 2 techniques.

CONCLUSIONS: The results show that both lateral window and transcrestal sinus augmentation techniques are viable options when residual bone height is 4–6 mm. However, transcrestal technique may be beneficial for patients due to less intraoperative discomfort and postoperative swelling.


Dimensional Changes in Peri-implant Buccal Bone in Augmented and Native Bone: A Literature Review
Min-Ying Li, Yong Hur, and Yumi Ogata

BACKGROUND AND AIM: The stability of peri-implant buccal bone is a significant determinant of soft tissue profile and long-term esthetic outcome. The present review aimed to explore the current literature regarding the data concerning dimensional changes in peri-implant buccal bone between implants placed in augmented and native bone.

METHODS: An electronic search of PubMed (MEDLINE) and the Cochrane databases was performed to identify studies published in English until August 2017. Randomized clinical trials and prospective clinical studies reporting vertical and horizontal dimensional changes in peri-implant buccal bone with a minimal follow-up of 12 months were selected. Animal studies were excluded.

RESULTS: A total of 7 articles met the eligibility criteria. For vertical dimensional changes, 4 CBCT studies were included, with a 1- to 5-year follow-up period. Among them, 2 studies focused on the changes in native bone while the other 2 studies compared different membranes in augmented bone. In regards to horizontal changes, 3 studies reported the data in native bone, with 1-year post-op or post-loading follow up. No studies were available in augmented bone. Articles comparing dimensional changes between implants placed in augmented and native bone could not be retrieved.

CONCLUSION: There is a paucity of data regarding the stability of peri-implant buccal bone. Due to the heterogeneity among studies (e.g., follow-up period, timing of bone augmentation and implant placement, implant system, bone graft materials and membranes), it was not possible to make a comparison between augmented and native bone. Further well-designed randomized clinical trials are needed to elucidate this question.

Presented at EuroPerio9, Amsterdam, 2018.
Using Evidence-Based Dentistry in the Clinical Management of Combined Periodontal Conditions

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OBJECTIVE: This report proposes a framework to integrate evidence-based dentistry (EBD) in a systematic approach in the clinical management of a patient diagnosed with drug-induced gingival hyperplasia combined with generalized aggressive periodontitis. This report illustrates the case of a 37-year-old female who presented to the Department of Periodontology at Tufts University School of Dental Medicine with enlarged, tender, and bleeding gums and loose teeth combined with a history of uncontrolled hypertension treated with calcium channel blockers.

METHODS: Incorporating the EBD process, a new 5-step framework is proposed: ask the clinical question, acquire the evidence, appraise the evidence, apply it in the clinical setting, and assess the subjective and objective outcomes. Articles on aggressive periodontitis and/or gingival enlargement were sought using the assistance of an expert librarian. The search was conducted on the PubMed, Embase, and Scopus databases.

RESULTS: Initial literature search identified 34 publications. Articles were reviewed by 2 clinicians, and 31 relevant articles were selected. Of the references, 26 matched the levels of evidence initially agreed upon. Based on the scientific evidence, patient's chief complaint, and clinical expertise, a decision tree highlighting treatment options was compiled. The outcomes of the clinical management revealed that combined conditions can be successfully treated with nonsurgical therapy before proceeding with surgical therapy.

CONCLUSION: Within the limitations of this study, integrating EBD concepts was a reliable method to treat an atypical case, where 2 severe periodontal conditions were combined: drug-induced gingival enlargement and generalized aggressive periodontitis.

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Family History of MI, Smoking, and Risk of Periodontal Disease

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Periodontal disease (PD) shares common risk factors with cardiovascular disease. Our hypothesis was that having a family history of myocardial infarction (FamHxMI) may be a novel risk factor for PD. Risk assessment based on FamHxMI, conditional on smoking status, was examined given the strong influence of smoking on PD. Exploratory analysis with inflammatory biomarkers and genetic determinants was conducted to understand potential mechanistic links. The Women's Genome Health Study (WGHS) is a prospective cohort of U.S. female healthcare professionals who provided blood samples at baseline in the Women's Health Study, a 2 × 2 factorial clinical trial investigating vitamin E and aspirin in the prevention of cardiovascular disease and cancer. PD was ascertained via self-report over 12 y of follow-up. Prevalence (3,442 cases), incidence (1,365 cases), and survival analysis of PD were investigated for associations of FamHxMI as well as in strata of FamHxMI by smoking. Kruskal-Wallis, chi-square tests, multivariate regression, and Cox proportional hazard models were used for the analyses. In the WGHS, women with FamHxMI showed higher risk of ever having PD. A particularly high-
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risk group of having both FamHxMI and smoking at baseline was highlighted in the prevalence and risk of developing PD. PD risk increased according to the following strata: no FamHxMI and nonsmokers (reference), FamHxMI and nonsmokers (hazard ratio [HR]=1.2, 95% CI=1.0 to 1.5), smokers without FamHxMI (HR=1.3, 95% CI=1.2 to 1.5), and smokers with FamHxMI (HR=1.5, 95% CI=1.2 to 1.8). An independent analysis by the dental Atherosclerosis Risk in Communities study (N=5,552) identified more severe periodontitis cases among participants in the high-risk group (smokers with FamHxMI). Further examination of interactions among inflammatory biomarkers or genetic exploration with FamHxMI did not explain the risk increase of PD associated with FamHxMI in the WGHS. Future efforts based on an integrative-omics approach may facilitate validation of these findings and suggest a mechanistic link between PD and FamHxMI.


Co-expression Networks Highlighted among Genomic Determinants of Periodontal Disease

Yau-Hua Yu* and Bjorn Steffensen

OBJECTIVES: Several genome-wide association studies (GWAS) were published to date. However, limited number of single nucleotide polymorphisms (SNPs) were identified above the genome-wide statistical significance (p<10^-8). In addition, none of the published GWAS independently replicated the reported SNPs. Recent advances in the understanding of human expression quantitative trait loci (eQTL), together with functional enrichment annotation, differential expression profiles, and co-expression networks in the gingival tissue, provide an integrative yet focused view of the underlying biology of these reported SNPs.

METHODS: There are 141 unique SNPs derived from prior published periodontal disease GWAS in the GWAS catalog. We used Genotype-Tissue Expression (GTEx) project for investigating SNPs associated with any eQTL. Among 29 SNPs that were listed in the GTEx, we compared expression profiles of the disease vs. control gingival tissue (GEO GSE16134; disease, N=241; control, N=69). Using differential expression analyses (bioconductor limma package), false discovery rate (FDR) correction, and co-expression analyses, we highlighted potential periodontal disease targets in network structure.

RESULTS: Twenty-nine SNPs from the periodontal disease GWAS were associated with eQTL in GTEx. A total of 72 Affymetrix probe sets were converted via Entrez GeneIDs. Using the NIH Database for Annotation, Visualization and Integrated Discovery (DAVID), the top enriched cluster was annotated with apoptosis, inflammatory response, and innate immunity (see figure). Forty-one SNPs demonstrated differential expression after FDR correction. Among these, 22 probes demonstrated higher concordance of expression patterns (70% consistency) comparing periodontal disease vs. control gingival tissue. Using Pearson correlation coefficient cut-off at 60% co-expression, we demonstrated distinct topological inter-relationships among these co-expressed genes in the disease vs. control gingival tissue (see figure). Information of eQTL tissue type, original SNPs reported, and probe sets used are provided in the table.
**Gene** | **Chr** | **PD SNP** | **SNP Content** | **PD GWAS** | **GTEx Tissue** | **Pv (Ging Tissue)** | **Exprs* (PD)** | **Exprs* (Ctrl)** | **Affy Probe Set**
---|---|---|---|---|---|---|---|---|---
SS18 | 18q11.2 | rs11877878 | intron | Teumer A | Testis | 5.33E-07 | -0.15 | 0.52 | 202816_s_at
PCYT1A | 3q29 | rs1156327 | intergenic | Offenbacher S | Lung | 9.05E-09 | -0.17 | 0.6 | 204210_s_at
TMEM40 | 3p25.2 | rs2569991 | intron | Teumer A | Skin | 1.05E-13 | -0.22 | 0.77 | 222892_s_at, 219503_s_at
LBP | 20q11.23 | rs11536940 | intron | Teumer A | Lung | 1.74E-15 | 0.24 | -0.82 | 211652_s_at
NME8 | 7p14.1 | rs2392510 | intron | Shimizu S | Skin, Adipose, Lung, Whole blood, Spleen | 5.21E-06 | 0.14 | -0.47 | 220384_at
GFM1 | 3q25 | rs6802315 | intron | Teumer A | Skin, Thyroid | 5.32E-07 | -0.15 | 0.52 | 232296_s_at
SPINK7 | 5q32 | rs10043775 | missense | Divaris K | Skin | 2.02E-07 | -0.15 | 0.54 | 223720_at

**CONCLUSIONS:** Using integrative-omics approach successfully provides highlighted targets for future research of periodontal disease. Validation in an independent analysis will provide a better understanding of these genomic determinants of periodontal disease.

*Presented at the 2018 AADR Annual Meeting in Fort Lauderdale, Florida. Abstract 0393.*
PHARMACOLOGY/Therapeutics/TOXICOLOGY

Perception of an Experimental Mouthwash in People with Dry Mouth

Nicolette Kafasis,* Mabi Singh, Arwa Farag, Athena Papas, Britta Magnuson, Bhavik Desai, Elizabeth Tzavaras, Anto Jose, and Roshan Varghese

OBJECTIVES: To investigate perception of an experimental mouthwash (MW) compared to water.

METHODS: A randomized, examiner-blind, single use, crossover study in participants with (N=22) or without (N=33) Sjögren’s syndrome (SS) experiencing dry mouth symptoms. Participants swished with 15 mL of assigned product for 30 seconds, then expectorated. They completed a postproduct use questionnaire immediately and 30 minutes after use. Primary efficacy was response to the statement, “This product is gentle,” on a 5-item Likert scale.

RESULTS: Most participants found both treatments “gentle” though fewer with SS in the MW group agreed with this statement. Immediately and 30 minutes postuse a higher percentage of participants found the MW “moisturizing,” “soothing,” and “refreshing” than with water. Some felt the MW caused “tingling,” “numbing,” “burning,” and “drying out of their mouth” immediately postuse with all but “drying out” lessening by 30 minutes. One mild, non-oral, treatment-emergent but not treatment-related adverse-event was reported by a MW group participant.

CONCLUSIONS: Most agreed that the experimental MW was “gentle” with results for those with or without SS generally consistent with those for the overall population. Participants found the MW “moisturizing,” “soothing,” and “refreshing” up to 30 minutes postuse. Both treatments were generally well-tolerated.

Presented at the 2018 AADR Annual Meeting in Fort Lauderdale, Florida. Abstract 1455.

Comparison of Blood Values in Sjögren’s and Sicca Patients

Athena Papas, Mabi Singh, Joseph Cimmino, Elizabeth Tzavaras, and Zuhair Natto

OBJECTIVES: Diagnosis of Sjögren’s is difficult. We have seen a correlation between FACIT and ESSDAI in our sicca clinic population that is significant to the 0.0001 level in 129 patients. We had blood values available for 39 of these patients and explored to see if any of their blood values differed between confirmed Sjögren’s and sicca patients. We especially looked at inflammatory markers and immunoglobulins in particular. Our objective was to analyze relationship between different blood values and Functional Assessment of Chronic Illness Therapy (FACIT) scores in Sjögren’s and sicca.

METHODS: Thirty-nine (2 males) patients with mean age of 61.3±11.7 for the Sicca and 56.2±12.8 and were included in the study. Of these, 18 sicca and 21 were diagnosed Sjögren’s. Reported blood values for WBC, absolute basophils, eosinophils, monocytes, lymphocytes, and neutrophil, rbc, hct, hb, platelets, creatinine, esr, C3, C4, CK, crp, cryoglobulin, IGG, IGM, IGA, ANA, SSA, SSB, and RF were measured. The mean of FACIT scores and ESSDAI scores were calculated

RESULTS: The mean FACIT scores calculated were 27.24 (+) for Sicca and 38.64 (+) for Sjögren’s. The mean ESSDAI scores were 5.28±4.96 for Sicca and 10.24±13.19 for Sjögren’s. Kruskal-Wallis analysis showed that CRP, SSA, SSB, IGG, IGM were significantly different in Sjögren’s vs. sicca patients (see table).
CONCLUSIONS: Immunoglobulins, CRP ESSDAI, and fatigue scores among sicca and diagnosed Sjögren’s should be looked at in addition to SSA and lip biopsy when diagnosing and treating Sjögren’s syndrome. Larger studies need to be conducted to establish this relationship.

Presented at the 2018 AADR Annual Meeting in Fort Lauderdale, Florida. Abstract 0076.

 Evaluation of Sensory Attributes of an Experimental Mouthwash

Mabi Singh,* Anto Jose, Arwa Farag, Britta Magnuson, Nicolette Kafasis, Elizabeth Tzavaras, Bhavik Desai, Roshan Varghese, and Athena Papas

OBJECTIVES: To investigate sensory attributes of an experimental mouthwash (MW) as measured by the postproduct use sensory questionnaire (PPUSQ) vs. water.

METHODS: A randomised, examiner blind, parallel group trial in participants with (N=28) or without (N=72) Sjögren’s syndrome (SS) experiencing dry mouth symptoms. Under supervision, participants swished with 15 mL of MW for 30 seconds (N=53) or sipped 15 mL of water (N=47). They completed the PPUSQ immediately after supervised use on Days 1, 3, and 8. Participants rated: Q1) How much they liked the product (1–6 scale from “Did not like it at all” to “Like it extremely”); Q2) How pleasant the flavor was (1–5 scale from “Not pleasant at all” to “Extremely pleasant”); Q3) How gentle the product was (1–7 scale from “Not gentle at all” to “The most gentle product imaginable”); and Q4) How fresh their mouth felt after using the product (1–5 scale from “Not at all fresh” to “Extremely fresh”).

RESULTS: Difference is MW group score minus water group score; a positive difference favors the MW group (Table 1). Overall there were few between-group differences in terms of liking the product and rating the flavor pleasantness. The MW was perceived as more fresh with water perceived as more gentle. Based on adverse events, study products were generally well-tolerated.

CONCLUSIONS: Mean PPUSQ scores immediately after use indicated similarities between water and an experimental MW for likability and pleasantness but differences for gentleness and freshness.

Presented at the 2018 AADR Annual Meeting in Fort Lauderdale, Florida. Abstract 0080.
**PROSTHODONTICS RESEARCH**

**Internal Adaptions of Fixed Partial Dentures Obtained from Different Digital Impressions**

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**OBJECTIVES:** The purpose of this study was to test the accuracy of axial and occlusal adaptations of final restoration fabricated using 5 digital and 1 conventional dental impression systems.

**MATERIAL AND METHODS:** A 3-unit bridge model was designed to be used as a reference model. Dental impressions (N=5) from 4 different digital impression systems (CEREC, E4D, Lava C.O.S, 3Shape, iTero) and 1 conventional impression system (Polyether) were made. Master models of the digital impressions were printed out according to the manufacturer recommendations, and for the conventional impression group, the master models were poured out of type IV dental stone. Final restorations were fabricated using CAD/CAM technology on the produced master models. The final restorations were tested for axial and occlusal adaptation on the reference model using cement replica technique.

**RESULTS:** Axial adaptations (µm) were as follows: 3Shape 253 (13), CEREC 249 (15), E4D 287 (29), Stone 222 (13), Lava 195 (23), and iTero 234 (20), one-way ANOVA test was significant (p≤0.001). The occlusal adaptations (µm) were as follows: Lava 236 (19), iTero 313 (12), 3Shape 332 (52), CEREC 314 (25), E4D 392 (32), and Stone 353 (52), one-way ANOVA test was significant (p≤0.001). The correlations between axial and occlusal adaptations were positive for all the comparisons.

**CONCLUSIONS:** Within the limitations of this study, the following conclusions were drawn: There is a statistically significant difference between the axial and occlusal adaptation of the tested systems.

*Presented at the 2018 AADR Annual Meeting in Fort Lauderdale, Florida. Abstract 1106.*

**Management of Technical Complications during Full-Mouth Implant Rehabilitation with Hybrid Prostheses over a Seven-Year Period**

*Bahaa Alshawaf, Yukio Kudara, Hans-Peter Weber, and Panos Papaspypridakos*

Monolithic ceramics have been introduced in dentistry to help reduce technical complications reported with implant-supported metal-resin hybrid prostheses. This clinical report describes the maintenance and technical complications that occurred during a full-mouth implant rehabilitation using different prosthetic materials over a 7-year period. During the course of 4 of those years, multiple technical complications were encountered with the metal-resin hybrid prostheses, prompting the need for increased maintenance. New prostheses were inserted with screw-retained titanium frameworks and individually cemented single crowns, and subsequently no technical complications were encountered after 2 years of follow-up.

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Digital vs. Conventional Full-Arch Implant Impressions: A Comparative Study
Sarah Amin, Hans-Peter Weber, Matthew Finkelman, Khaled El Rafie, Yukio Kudara, and Panos Papaspyridakos

PURPOSE: To test whether or not digital full-arch implant impressions with 2 different intra-oral scanners (CEREC Omnicam and True Definition) have the same accuracy as conventional ones. The hypothesis was that the splinted open-tray impressions would be more accurate than digital full-arch impressions.

MATERIAL AND METHODS: A stone master cast representing an edentulous mandible using 5 internal connection implant analogs (Straumann Bone Level RC, Basel, Switzerland) was fabricated. The 3 median implants were parallel to each other, the far left implant had 10 degrees, and the far right had 15 degrees distal angulation. A splinted open-tray technique was used for the conventional polyether impressions (N=10) for group 1. Digital impressions (N=10) were taken with 2 intra-oral optical scanners (CEREC Omnicam and 3M True Definition) after connecting polymer scan bodies to the master cast for groups 2 and 3. Master cast and conventional impression test casts were digitized with a high-resolution reference scanner (Activity 880 scanner; Smart Optics, Bochum, Germany) to obtain digital files. Standard tessellation language (STL) datasets from the 3 test groups of digital and conventional impressions were superimposed with the STL dataset from the master cast to assess the 3D deviations. Deviations were recorded as root-mean-square error. To compare the master cast with conventional and digital impressions at the implant level, Welch's F-test was used together with Games-Howell post hoc test.

RESULTS: Group 1 had a mean value of 167.93 µm (SD 50.37); group 2 (Omnican) had a mean value of 46.41 µm (SD 7.34); group 3 (True Definition) had a mean value of 19.32 µm (SD 2.77). Welch's F-test was used together with the Games-Howell test for post hoc comparisons. Welch's F-test showed a significant difference between the groups (p<0.001). The Games-Howell test showed statistically significant 3D deviations for all 3 groups (p<0.001).

CONCLUSION: Full-arch digital implant impressions using True Definition scanner and Omnicam were significantly more accurate than the conventional impressions with the splinted open-tray technique. Additionally, the digital impressions with the True Definition scanner had significantly less 3D deviations when compared with the Omnicam.


Clinical Results and Technical Complications of Posterior Implant-Supported Modified Monolithic Zirconia Single Crowns and Short-Span Fixed Dental Prostheses: A Two-Year Pilot Study
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PURPOSE: The purpose of this clinical trial was to investigate the clinical outcomes of implant-supported modified monolithic zirconia single crowns (SCs) and short-span fixed dental prostheses (FDPs) after a follow-up of 2 years.
MATERIALS AND METHODS: Twenty-seven patients in need of implant-supported SCs or 3-unit FDPs in the posterior maxilla or mandible were consecutively selected for this study. A total of 56 modified monolithic zirconia prostheses including 44 SCs (8 screw-retained, 36 cement-retained) and 12 3-unit FDPs (5 screw-retained, 7 cement-retained) were included in this study. All patients were followed at 6 months, 12 months, 18 months, and 2 years after placement of the modified monolithic zirconia prostheses. During the follow-up period, all prostheses were evaluated with clinical and radiographic examinations. The following technical parameters were assessed: framework fracture, fracture of veneering porcelain, screw loosening, loss of retention because of prosthesis de-cementation and opposing tooth fracture.

RESULTS: No implant was lost during the follow-up period, yielding a 2-year implant survival of 100%. One FDP failed because of framework fracture. The overall prosthesis survival rate was 98.2% after 2 years of clinical service. During the study, 5 complication events were observed in 3 SCs and 1 FDP, including 1 fracture of veneering porcelain and 2 screw loosenings in 3 SCs and loss of retention and opposing tooth fracture in the same FDP. Therefore, the complication-free rate of prostheses was 91.1%.

CONCLUSION: According to the results of this study, the modified monolithic zirconia design used in this study resulted in a favorable short-term outcome for posterior implant-supported SCs and 3-unit FDPs.


Contemporary Management and Full-Mouth Rehabilitation of a Patient with Sjögren’s Syndrome

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Sjögren’s syndrome is a chronic autoimmune disorder with xerostomia, increased tooth wear, high rates of caries, and repeated failure of dental restorations as the main oral symptoms. These render the prosthetic treatment challenging. This clinical report describes a contemporary approach to the treatment of a patient with Sjögren’s syndrome using translucent multilayered monolithic zirconia restorations and focuses on the treatment protocols before, during, and after the prosthetic treatment.


Restoration of Facial Form and Lip Competence in a Patient with a Midfacial Defect

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Squamous cell carcinoma (SCC) of the head and neck can be treated with a combination of modalities. There is an aesthetic and functional compromise with midfacial defects secondary to ablative surgery and adjuvant therapies for SCC. Osteoradionecrosis, tissue contracture, and trismus are all negative side effects of treatment and can impact a patient’s function and possibly their nutrition. In this report, we describe a procedure for fabrication of a prosthesis that provides cosmetic improvement and labial competence to maintain caloric intake.

**Effect of Grinding and Polishing on Roughness and Strength of Zirconia**

**Waad Khayat,¹ Najla Chebib,² Matthew Finkelman,¹ Samer Jhayat,¹ and Ala Ali¹**

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**STATEMENT OF PROBLEM:** The clinical applications of high-translucency monolithic zirconia restorations have increased. Chairside and laboratory adjustments of these restorations are inevitable, which may lead to increased roughness and reduced strength. The influence of grinding and polishing on high-translucency zirconia has not been investigated.

**PURPOSE:** The purpose of this in vitro study was to compare the roughness averages (Ra) of ground and polished zirconia and investigate whether roughness influenced strength after aging.

**MATERIAL AND METHODS:** High-translucency zirconia disks were milled, sintered, and glazed according to the manufacturer's recommendations. Specimens were randomized to 4 equal groups. Group G received only grinding; groups GPB and GPK received grinding and polishing with different polishing systems; and group C was the (unground) control group. All specimens were subjected to hydrothermal aging in an autoclave at 134°C at 200 kPa for 3 hours. Roughness average was measured using a 3-dimensional (3D) optical interferometer at baseline (Ra1), after grinding and polishing (Ra2), and after aging (Ra3). A biaxial flexural strength test was performed at a rate of 0.5 mm/min. Statistical analyses were performed using commercial software (alpha=0.05).

**RESULTS:** Group G showed a significantly higher mean value of Ra3 (1.96±0.32 μm) than polished and glazed groups (p<0.001), which showed no statistically significant difference among them (GPB, 1.12±0.31 μm; GPK, 0.88±0.31 gm; C: 0.87±0.25 gm) (p>0.05). Compared with baseline, the roughness of groups G and GPB increased significantly after surface treatments and after aging, whereas aging did not significantly influence the roughness of groups GPK or C. Group G showed the lowest mean value of biaxial flexural strength (879.01±157.99 MPa), and the highest value was achieved by group C (962.40±113.84 MPa); no statistically significant differences were found among groups (p>0.05). Additionally, no significant correlation was detected between the Ra and flexural strength of zirconia.

**CONCLUSIONS:** Grinding increased the roughness of zirconia restorations, whereas proper polishing resulted in smoothness comparable with glazed surfaces. The results provide no evidence that grinding and polishing affect the flexural strength of zirconia after aging.


**Digital vs. Conventional Implant Impressions for Partially Edentulous Arches: An Evaluation of Accuracy**

**Amin Marghalani, Hans-Peter Weber, Matthew Finkelman, Yukio Kudara, Khaled El Rafie, and Panos Papaspyridakos**

**STATEMENT OF PROBLEM:** To the authors’ knowledge, while accuracy outcomes of the TRIOS scanner have been compared with conventional impressions, no available data are available regarding the accuracy of digital scans with the Omnicam and True Definition scanners vs. conventional impressions for partially edentulous arches.

**PURPOSE:** The purpose of this in vitro study was to compare the accuracy of digital implant scans using 2 different intraoral scanners (IOSs) with that of conventional impressions for partially edentulous arches.
MATERIAL AND METHODS: Two partially edentulous mandibular casts with 2 implant analogs with a 30-degree angulation from 2 different implant systems (Replace Select RP; Nobel Biocare and Tissue level RN; Straumann) were used as controls. Sixty digital models were made from these 2 definitive casts in 6 different groups (N=10). Splinted implant-level impression procedures followed by digitization were used to produce the first 2 groups. The next 2 groups were produced by digital scanning with Omnicam. The last 2 groups were produced by digital scanning with the True Definition scanner. Accuracy was evaluated by superimposing the digital files of each test group onto the digital file of the controls with inspection software.

RESULTS: The difference in 3-dimensional (3D) deviations (median interquartile range) among the 3 impression groups for Nobel Biocare was statistically significant among all groups (p<0.001), except for the Omnicam (20±4 µm) and True Definition (15±6 µm) groups; the median ± interquartile range for the conventional group was 39±18 µm. The difference in 3D deviations among the 3 impression groups for Straumann was statistically significant among all groups (p=0.003), except for the conventional impression (22±5 µm) and True Definition (17±5 µm) groups; the median interquartile range for the Omnicam group was 26±15 µm. The difference in 3D deviations between the 2 implant systems was significant for the Omnicam (p=0.011) and conventional (p<0.001) impression techniques but not for the True Definition technique (p=0.247).

CONCLUSIONS: Within the limitations of this study, both the impression technique and the implant system affected accuracy. The True Definition technique had the fewest 3D deviations compared with the other 2 techniques; however, the accuracy of all impression techniques was within clinically acceptable levels, and not all differences were statistically significant.


Technique to Match Gingival Shade When Using Pink Ceramics for Anterior Fixed Implant Prostheses

Panos Papaspyridakos, Sarah Amin, Khaled El Rafie, and Hans-Peter Weber

Use of pink gingival ceramics can reduce the necessity for extensive surgical procedures attempting to restore missing soft and hard tissues in the maxillary esthetic zone. Selecting the appropriate shade for pink porcelain poses a challenge, especially when the patient presents with a high smile line. This paper describes a simple and effective technique to facilitate shade selection for gingival ceramics to match the patient's existing gingival shade.


Digital Workflow in Full-Arch Implant Rehabilitation with Segmented Minimally Veneered Monolithic Zirconia Fixed Dental Prostheses: Two-Year Clinical Follow-Up

Panos Papaspyridakos, Kiho Kang, Catherine DeFuria, Sarah Amin, Yukio Kudara, and Hans-Peter Weber

OBJECTIVE: To illustrate a digital workflow in full-arch implant rehabilitation with minimally veneered monolithic zirconia and to report the outcomes including technical complications.
CLINICAL CONSIDERATIONS: Three patients (5 edentulous arches) received full-arch fixed implant rehabilitation with monolithic zirconia and mild facial porcelain veneering involving a digital workflow. The incisal edges and occluding surface areas were milled out of monolithic zirconia to reduce the possibility of chipping. Porcelain veneering was applied on the facial aspect to improve the esthetic result. Outcomes and technical complications are reported after 2 years of clinical and radiographic follow-up.

CONCLUSION: Implant and prosthesis survival rates were 100% after a short-term follow-up of 2 years. Technical complications were encountered in one patient. They did not adversely affect prosthesis survival or patient satisfaction and were easily addressed. A digital workflow for the design and fabrication of full-arch monolithic zirconia implant fixed implant prostheses has benefits, but caution is necessary during CAD planning of the prosthesis to ensure a successful outcome. Long-term clinical studies are needed to corroborate the findings discussed in this report.

CLINICAL SIGNIFICANCE: This article presents an integrated digital workflow that was implemented for the implant-prosthodontic rehabilitation of 3 edentulous patients with monolithic zirconia prostheses. Monolithic zirconia has been successfully incorporated in implant prosthodontics in an effort to reduce the technical complications associated with bilayered ceramics. This workflow simplifies design and fabrication of the zirconia prostheses. However, caution should be taken during CAD planning of the prosthesis to make sure the zirconia cylinder is sufficiently thick at the interface with the titanium insert. Additionally, when cutback is planned for facial porcelain veneering, the functional occluding cusps and incisal edges should be fabricated in monolithic zirconia to avoid chipping.

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Digital Workflow: From Guided Surgery to Final Full-Arch Implant Prosthesis in Three Visits
Panos Papaspyridakos, Daniel Ben Yehuda, Neha Rajput, and Hans-Peter Weber

The purpose of this article is to report a digital workflow protocol for full-arch implant rehabilitation from guided surgery to final prosthesis in only 3 visits. This expedited protocol allows for implant placement with a surgical template generated from preoperative virtual planning and production of the CAD/CAM prosthodontic rehabilitation using a digital workflow. At the first visit, a guided implant placement protocol with the All-on-4 concept and immediate loading with the conversion prosthesis technique was done. At the same visit, final impression and interocclusal records, cast verification and mounting, as well as digital scanning of the conversion prosthesis were carried out. During the second visit, the framework try-in was performed. Lastly, the third visit included delivery of the final full-arch prosthesis opposed by a maxillary complete denture.

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An In Vitro Comparison of the Marginal Adaptation Accuracy of CAD/CAM Restorations Using Different Impression Systems
Marwa Shembesh, Ala Ali, Matthew Finkelman, Hans-Peter Weber, and Roya Zandparsa

PURPOSE: To compare the marginal adaptation of 3-unit zirconia fixed dental prostheses (FDPs) obtained from intraoral digital scanners (Lava True Definition, Cadent iTero), scanning of a conventional silicone impression, and the resulting master cast with an extraoral scanner (3Shape lab scanner).
MATERIALS AND METHODS: One reference model was fabricated from intact, noncarious, unrestored human mandibular left first premolar and first molar teeth (teeth #19 and #21), prepared for a 3-unit all-ceramic FDP. Impressions of the reference model were obtained using 4 impression systems (N=10): group 1 (PVS impression scan); group 2 (stone cast scan); group 3 (Cadent iTero); and group 4 (Lava True Definition). Then the 3-unit zirconia FDPs were milled. Marginal adaptation of the zirconia FDPs was evaluated using an optical comparator at 4 points on each abutment. The mean (SD) was reported for each group. One-way ANOVA was used to assess the statistical significance of the results, with post hoc tests conducted via Tukey’s HSD; p<0.05 was considered statistically significant. All analyses were done using SPSS 22.0.

RESULTS: The mean (SD) marginal gaps for the recorded data from highest to lowest were: silicone impression scans 81.4 m (6.8); Cadent iTero scan 62.4 m (5.0); master cast scan 50.2 m (6.1); and Lava True definition scan 26.6 m (4.7). One-way ANOVA revealed significant differences (p<0.001) in the mean marginal gap among the groups. The Tukey’s HSD tests demonstrated that the differences between all groups (silicone impression scan, master cast scan, Lava True definition scan, iTero Cadent scan) were statistically significant (all p<0.001). On the basis of the criterion of 120 m as the limit of clinical acceptance, all marginal discrepancy values of all groups were clinically acceptable.

CONCLUSIONS: Within the confines of this in vitro study, it can be concluded that the marginal gap of all impression techniques was within the acceptable clinical limit (120 m). Group 4 (Lava True Definition) showed the lowest average gap among all groups followed by group 2 (stone cast scan), group 3 (Cadent iTero), and group 1 (PVS impression scan); these differences were statistically significant.

PULP BIOLOGY AND REGENERATION RESEARCH

Progress in Creating a Biomimetic Dental Cell Sheet GelMA Tooth Bud

Nelson Monteiro,* Weibo Zhang, Elizabeth Smith, Winnie Costa, Shantel Angstadt, and Pamela Yelick

OBJECTIVES: Our objective was to characterize dental cell (DC) differentiation and mineralized dental tissue formation in a novel biomimetic 3-dimensional (3D) tooth bud model consisting of dental epithelial (DE), dental mesenchymal (DM) and HUVEC cell sheets (DE-HUVEC, DM-HUVEC), combined with dental cell-HUVEC encapsulated gelatin methacrylate (GelMA) hydrogel scaffolds.

METHODS: Porcine DM (0.114 × 10^6 cell/cm^2) or DE (0.228 × 10^6 cell/cm^2) cells were seeded onto UpCell thermo-responsive tissue culture plates. After 12 days, HUVECs (0.057 × 10^6/cm^2) were seeded on top, and DE-HUVEC and DM-HUVEC cell sheets were harvested after 14 days. Stacked DE-HUVEC/DM-HUVEC cell sheets were then sandwiched between GelMA encapsulated DE-HUVEC and DM-HUVEC cell layers (ESM), and cultured in vitro for 7 days in osteogenic media and implanted and grown in vivo for 1, 3 and 6 weeks. Control constructs were also examined. In vivo mineralization was assessed and quantified using microCT (Bruker). Dental cell differentiation and neovascularization were assessed using immunohistological and immunohistochemical analyses.

RESULTS: In vivo implanted 3D tooth bud constructs exhibited mineralized tissue formation of specified size and shape in ESM, DE-DM, M, and MSM constructs, and mineralized tissue density increased over in vivo implantation time. Highest volumes of most dense mineralized tissues were observed in ESM constructs at 6 weeks. Histological evaluations of paraffin embedded and serial sectioned 3D biomimetic tooth bud constructs showed dental cell differentiation marker expression and neo-vasculature formation.

CONCLUSIONS: Dental cell sheet containing GelMA constructs exhibited the highest mineralized tissue formation as compared to other 3D tooth bud constructs. We propose our biomimetic 3D Gelma cell sheet tooth bud construct as a model to study dental cell differentiation and mineralized dental tissue formation leading to the formation of functional biomimetic replacement teeth.

Presented at the 2018 AADR Annual Meeting in Fort Lauderdale, Florida. Abstract 1718.
SALIVARY AND LACRIMAL GLAND RESEARCH

Manipulation of Panx1 Activity Increases the Engraftment of Transplanted Lacrimal Gland Epithelial Progenitor Cells

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PURPOSE: Sjögren’s syndrome is a systemic chronic autoimmune inflammatory disease that primarily targets the salivary and lacrimal glands (LGs). Currently there is no cure; therefore, cell-based regenerative therapy may be a viable option. LG inflammation is facilitated by extracellular ATP and mediated by the Pannexin-1 (Panx1) membrane channel glycoprotein. We propose that suppression of inflammation through manipulation of Panx1 activity can stimulate epithelial cell progenitor (EPCP) engraftment.

METHODS: The expression of pannexins in the mouse and human LG was assayed by qRT-PCR and immunostaining. Acute LG inflammation was induced by interleukin-1α (IL1α) injection. Prior to EPCP transplantation, IL1α-injured or chronically inflamed LGs of thrombospondin-1–null mice (TSP-1−/−) were treated with the Panx1-specific blocking peptide (10panx) or the self-deliverable RNAi (sdRNAi). The efficacy of cell engraftment and the area of inflammation were analyzed by microscopy.

RESULTS: Panx1 and Panx2 were detected in the mouse and human LGs. Panx1 and proinflammatory factors were upregulated during acute inflammation at days 1 to 3 after the IL1α injection. The analysis of EPCP engraftment demonstrated a significant and reproducible positive correlation between the 10panx peptide or Panx1 sdRNAi treatment and the number of engrafted cells. Similarly, treatment of the LG of the TSP-1−/− mouse (mouse model of chronic LG inflammation) by either Panx1 or Caspase-4 (also known as Casp11) sdRNAi showed a significant decrease in expression of proinflammatory markers and the lymphocyte infiltration.

CONCLUSIONS: Our results suggest that blocking Panx1 and/or Casp4 activities is a beneficial strategy to enhance donor cell engraftment and LG regeneration through the reduction of inflammation.


Evaluation of Dental Status and Tooth-Surface Loss in Patients with Hyposalivation

Amr Bugshan,* Arwa Farag, Zuhair Natto, Deanna Buonomo, Nicolette Kafasis, Mabi Singh, and Athena Papas

OBJECTIVES: Salivary hypofunction may lead to increased risk of dental caries and noncarious tooth surface loss (erosion). The aim of this study is to compare the prevalence of dental caries and tooth surface loss in patients with confirmed hyposalivation based on their Sjögren’s syndrome (SS) status.

METHODS: This study comprised of 17 patients diagnosed with SS (+ve SSA and/or SSB) and 10 non-SS (−ve...
SSA and/or SSB). Unstimulated salivary flow rate was confirmed to be ≤0.1 ml/min in all patients. Decayed-Missing-Filled surface (DMFS) index was used for both coronal and root caries measurement and dental status. Both DMFS index and tooth wear index (Smith and Knight tooth wear index) data were documented. The results were analyzed descriptively and with Mann-Whitney and independent samples tests, considering p<0.05 as statistically significant.

RESULTS: On average, the non-SS patients had 25.4 teeth surfaces missing, whereas 9 missing surfaces were found among SS patients (p=0.032). In addition, SS patients showed statistically significant higher number of teeth with an established decay compared to non-SS patients (p=0.06). The mean for noncaries tooth surface loss was 17.1 and 17.5 for SS and non-SS patients, respectively (p=0.919). There was no statistically significant difference between the 2 groups with respect to other variables including tooth fillings and prosthetic dental crowns.

CONCLUSIONS: Even though the diagnosis with SS may alter the patients’ personal oral hygiene behavior by increasing their motivation for having better oral hygiene and access to dental care, salivary hypofunction remains a critical risk factor for development of dental caries and tooth surface loss in patients with dry mouth. Also, serologically negative SSA and SSB may not indicate absence of other underlying medical conditions. This ongoing study will have a larger sample size and more accurate representative data.

Presented at the 2018 AADR Annual Meeting in Fort Lauderdale, Florida. Abstract 0416.

Myoepithelial Cell-Driven Acini Contraction in Response to Oxytocin Receptor Stimulation Is Impaired in Lacrimal Glands of Sjögren’s Syndrome Animal Models

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The purpose of the present studies was to investigate the impact of chronic inflammation of the lacrimal gland, as occurs in Sjögren’s syndrome, on the morphology and function of myoepithelial cells (MECs). In spite of the importance of MECs for lacrimal gland function, the effect of inflammation on MECs has not been well defined. We studied changes in MEC structure and function in 2 animal models of aqueous deficient dry eye, NOD and MRL/lpr mice. We found a statistically significant reduction in the size of MECs in diseased compared to control lacrimal glands. We also found that oxytocin receptor was highly expressed in MECs of mouse and human lacrimal glands and that its expression was strongly reduced in diseased glands. Furthermore, we found a significant decrease in the amount of 2 MEC contractile proteins, alpha-smooth muscle actin (SMA) and calponin. Finally, oxytocin-mediated contraction was impaired in lacrimal gland acini from diseased glands. We conclude that chronic inflammation of the lacrimal gland leads to a substantial thinning of MECs, down-regulation of contractile proteins and oxytocin receptor expression, and therefore impaired acini contraction. This is the first study highlighting the role of oxytocin mediated MEC contraction on lacrimal gland function.

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**Safety and Effectiveness of a Two-Step Dentifrice/Gel Sequence with Medication-Associated Hyposalivation: A Randomized Controlled Trial in a Vulnerable Population**

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**PURPOSE:** A randomized controlled trial was conducted to evaluate the safety and effectiveness of a 2-step dentifrice/gel oral hygiene sequence in a vulnerable population.

**METHODS:** Prior to the research, institutional review was obtained for the protocol, consent, and advertising. The study targeted adults with medication-associated xerostomia, because of the plaque accumulation and possible oral safety risks seen in this population. Eligible subjects with a medication history and measured hyposalivation were randomly assigned to 1 of 2 oral hygiene groups: (1) a 2-step 0.454% SnF₂ dentifrice and 3% H₂O₂ gel sequence, or (2) a regular anticavity toothpaste control. Test products were dispensed with a regular manual brush in blinded over-labeled kits with usage instructions. Subjects were evaluated at baseline and after 2 and 6 weeks of test product use. Safety was assessed as adverse events from clinical examination and interview. Digital plaque image analysis of the anterior facial teeth measured fluorescein-disclosed daytime plaque levels, and unstimulated saliva was collected over a 5-minute period in pre-weighed vials.

**RESULTS:** A total of 49 subjects ranging from 31 to 80 years of age (53% female) were enrolled, and 45 completed Week 6. Only the 2-step dentifrice and gel sequence differed significantly (p<0.005) from baseline on daytime plaque coverage, and salivary flow increased significantly (p=0.033) in that group as well. Between-group comparisons for daytime plaque favored the 2-step sequence with 41–46% improvements in plaque control. At Week 6, adjusted daytime plaque means (SE) were 5.9 (0.7) and 10.0 (1.1) for the 2-step and control groups, respectively (p<0.004). Adverse events were mild in severity, groups differed significantly (p=0.02) on occurrence, and events did not contribute to dropout.

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**Meibomian Gland Dysfunction in Primary and Secondary Sjögren’s Syndrome**

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**PURPOSE:** We hypothesized that women with primary (pSS) and secondary Sjögren’s syndrome (sSS; with systemic lupus erythematosus [SLE] or rheumatoid arthritis [RA]) have meibomian gland dysfunction (MGD). We sought to test our hypothesis.

**METHODS:** Subjects with pSS, SLE + sSS, and non-SS-related MGD were recruited from the Sjögren’s Syndrome Foundation or outpatient clinics at Tufts University School of Dental Medicine or Brigham and Women’s Hospital. The control population was recruited from the greater Boston area. After providing written informed consent, the subjects underwent an eye examination and/or completed 2 questionnaires that assess symptoms of dry eye disease (DED).
**RESULTS:** Our results demonstrate that pSS and sSS patients have MGD. These subjects had meibomian gland orifice metaplasia, an increased number of occluded meibomian gland orifices, and a reduced quality of meibomian gland secretions. Further, patients with pSS, sSS + SLE, sSS + RA, and MGD had significant alterations in their tear film, lid margin, cornea, and conjunctiva. Symptoms of DED were increased ∼10-fold in all pSS, sSS, and MGD groups relative to controls.

**CONCLUSIONS:** Our findings support our hypothesis and show that individuals with pSS, sSS + SLE, and sSS + RA have MGD. In addition, our study indicates that patients with pSS and sSS have both aqueous-deficient and evaporative DED.

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STEM CELL RESEARCH

Induced Pluripotent Stem Cells from Ovarian Tissue

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Yamanaka and colleagues revolutionized stem cell biology and regenerative medicine by observing that somatic cells can be reprogrammed into pluripotent stem cells. Evidence indicates that induced pluripotent stem (iPS) cells retain epigenetic memories that bias their spontaneous differentiation into the originating somatic cell type; therefore, epigenetic memory may be exploited to improve tissue specific regeneration. We recently showed that iPS cells reprogrammed from ovarian granulosa cells using mouse and human tissue overwhelmingly differentiate homotypically into ovarian steroidogenic and primordial germ cells. Herein we detail a protocol for the culture of human ovarian granulosa cells. We review approaches for reprogramming human ovarian granulosa cells into iPS cells. Standard methods to induce pluripotency are outlined, concentrating on integrative retroviruses. Additionally, alternative protocols for lentivirus and Sendai virus are provided. Each approach has inherent limitations, such as reprogramming efficiency, insertional mutagenesis, and partial reprogramming. Major advances continue to be made in somatic cell reprogramming to identify an optimal approach and utilization in cell-based therapies.


Cell Therapies: New Frontier for the Management of Diabetic Foot Ulceration

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While stem cells hold great potential to improve existing therapies for diabetic foot ulcers, their promise has not been fully exploited. There is a critical need to further develop existing sources of adult stem cells known to improve DFU healing and to test novel, replenishing sources of pluripotent stem cells (iPSCs) that may overcome impaired wound repair when delivered to DFUs. This chapter summarizes the capacity of multiple adult stem cell sources, including bone-marrow-derived mesenchymal stem cells, hematopoetic stem cells, endothelial progenitor cells, bone marrow and peripheral blood mononuclear cells, and adipose stem cells, to improve DFU healing outcomes in preclinical animal models and human clinical trials. We also review novel technologies, such as iPSC-derived cell sources, CRISPR gene editing, and 3D human tissue models, to generate and modify stem cells that can give rise to multiple cell types needed for DFU healing and to streamline their preclinical testing. By further understanding how stem cells and other new technologies can best stimulate tissue regeneration, we will be able to overcome existing barriers to improve DFU therapies.

MicroRNA-99a Is a Novel Regulator of KDM6B-Mediated Osteogenic Differentiation of BMSCs

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Skeletal tissue originates from mesenchymal stem cells (MSCs) with differentiation potential into the osteoblast lineage regulated by essential transcriptional and posttranscriptional mechanisms. Recently, miRNAs and histone modifications have been identified as novel key regulators of osteogenic differentiation of MSCs. Here, we identified miR-99a and its target lysine (K)-specific demethylase 6B (KDM6B) gene as novel modulators of osteogenic differentiation of bone mesenchymal stem cells (BMSCs). Microarray profiling and further validation by quantitative real-time RT-PCR revealed that miR-99a was upregulated during osteoblastic differentiation of BMSCs, and decreased in differentiated osteoblasts. Transfection of miR-99a mimics inhibited osteoblastic commitment and differentiation of BMSCs, whereas inhibition of miR-99a by inhibitors enhances these processes. KDM6B was determined as one of important targets of miR-99a, which was further confirmed by luciferase assay of 3-UTR of KDM6B. Moreover, HOX gene level decreased after transfection of miR-99a mimics in BMSCs, which indicated that KDM6B is a bona fide target of miR-99a. Furthermore, in a model of in vivo bone regeneration, osteoblast-specific gain- and loss-of-function experiments performed using cranial bone defects revealed that miR-99a mimics-transfected BMSCs reduced bone formation, and conversely, miR-99a inhibitors-transfected BMSCs increased in vivo bone formation. Tissue-specific inhibition of miR-99a may be a potential novel therapeutic approach for enhancing BMSCs-based bone formation and regeneration.

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Tissue Engineering

Trophoblast Differentiation, Invasion, and Hormone Secretion in a Three-Dimensional In Vitro Implantation Model with Rhesus Monkey Embryos

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BACKGROUND: The initiation of primate embryo invasion into the endometrium and the formation of the placenta from trophoblasts, fetal mesenchyme, and vascular components are essential for the establishment of a successful pregnancy. The mechanisms that direct morphogenesis of the chorionic villi and the interactions between trophoderm-derived trophoblasts and the fetal mesenchyme to direct these processes during placentation are not well understood due to a dearth of systems to examine and manipulate real-time primate implantation. Here we describe an in vitro 3-dimensional (3D) model to study implantation which utilized IVF-generated rhesus monkey embryos cultured in a Matrigel explant system.

METHODS: Blastocyst stage embryos were embedded in a 3D microenvironment of a Matrigel carrier and cocultured with a feeder layer of cells generating conditioned medium. Throughout the course of embryo coculture, embryo growth and secretions were monitored. Embedded embryos were then sectioned and stained for markers of trophoblast function and differentiation.

RESULTS: Signs of implantation were observed including enlargement of the embryo mass and invasion and proliferation of trophoblast outgrowths. Expression of chorionic gonadotropin defined by immunohistochemical staining and secretion of chorionic gonadotropin and progesterone coincident with the appearance of trophoblast outgrowths supported the conclusion that a trophoblast cell lineage formed from implanted embryos. Positive staining for selected markers, including Ki67, MHC class I, NeuN, CD31, vonWillebrand Factor, and Vimentin, suggest growth and differentiation of the embryo following embedding.

CONCLUSIONS: This 3D in vitro system will facilitate further study of primate embryo biology, with potential to provide a platform for study of genes related to implantation defects and trophoblast differentiation.


In Vitro Skin Models Mimic Fibrogenic Signatures of Systemic Sclerosis

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Skin fibrosis is a common feature of systemic sclerosis (SSc). Skin equivalent tissues incorporating multiple cells types have not been previously reported for SSc. We have shown that human skin equivalents (hSE) are morphologically similar to human skin and can be used to study fibroblast behavior in a realistic 3D tissue microenvironment in which epithelial-dermal cross-talk is indispensable for recreating cell phenotypes observed in vivo. To understand if fibroblasts from SSc patients (SScDF) preserve their in vivo-fibrotic phenotypes in a 3D skin-like tissue in vitro, we incorporated SScDF isolated from skin biopsies of SSc patients
and site-, age-matched normal control dermal fibroblasts (NDF) into bovine Type I collagen to fabricate hSE. We then evaluated their ability to modify the properties of the ECM. Atomic force microscopy (AFM) was used to evaluate stromal rigidity. SScDF hSE showed a 4-fold higher stiffness than in NDF hSE. This suggested that SScDF modified the collagen matrix to increase stiffness similar to what is observed in SSc cutaneous fibrosis in patients. Since excess collagen production is a hallmark of SSc, de novo ECM production of fibroblasts was stimulated with ascorbic acid for 5 weeks to secrete and assemble a granulation tissue-like self-assembly (SA) tissue. SScDF produced thicker ECM compared to NDF assessed by histological stain. Consistent with the observation in hSE, SScDF SA showed an increased rigidity of de novo ECM deposition by AFM in comparison with NDF SA. SScDF-derived ECM contained more collagen than NDF-derived ECM as determined by hydroxyproline assay. Additionally, DNA microarray analyses of SA tissues showed inflammatory innate immune signaling genes observed in SSc skin biopsies were increased in SScDF SA tissues. These data demonstrate that relative to NDF, SScDF can reproducibly generate in vitro skin-like tissues with the thicker dermis, increased ECM stiffness, and show increased expression of innate immune signaling genes in the absence of other cell types. Over all, this study suggests that primary dermal fibroblasts from SSc patients can consistently mimic their in vivo fibrotic phenotypes when grown in skin-like 3D tissues.

Presented at the 15th International Workshop on Scleroderma Research, Pittsburgh, Pennsylvania.

**Bioengineered Tooth Buds Exhibit Features of Natural Tooth Buds**

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Tooth loss is a significant health issue currently affecting millions of people worldwide. Artificial dental implants, the current gold standard tooth replacement therapy, do not exhibit many properties of natural teeth and can be associated with complications leading to implant failure. Here we propose bioengineered tooth buds as a superior alternative tooth replacement therapy. We describe improved methods to create highly cellularized bioengineered tooth bud constructs that formed hallmark features that resemble natural tooth buds such as the dental epithelial stem cell niche, enamel knot signaling centers, transient amplifying cells, and mineralized dental tissue formation. These constructs were composed of postnatal dental cells encapsulated within a hydrogel material that were implanted subcutaneously into immunocompromised rats. To our knowledge, this is the first report describing the use of postnatal dental cells to create bioengineered tooth buds that exhibit evidence of these features of natural tooth development. We propose future bioengineered tooth buds as a promising, clinically relevant tooth replacement therapy.

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