SCHOOL OF DENTISTRY

Research Day

2026

Thursday, March 5

Robertson Life Science Building, Portland, OR

OHSU School of DENTISTRY

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Research Day
2026

Robertson Life Science Building, Portland, OR

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8:00 am Poster setup
RLSB Atrium

Refreshments such as coffee, tea, pastries, fruit, and bagels will be provided.

8:30 am Poster Session #1
(odd numbers)

10:10 am Poster Session #2
(even numbers)

This year, Research Day is honored to include guest abstracts from OHSU Collaborations and Entrepreneurship and the Pacific Northwest National Laboratory (PNNL).
We encourage attendees to explore their posters and engage with their teams.

12 noon Keynote and Awards
In-person at RLSB 3A003A/B
or online via Webex

Sack lunches will be offered on a first-come, first-served basis for attendees remaining for the lecture.

SCHOOL OF DENTISTRY PRESENTS THE 2026 RESEARCH DAY KEYNOTE SPEAKER

David Wong, D.M.D., D.M.Sc.

Salivaomics,
Saliva Exosomics,
Saliva Liquid Biopsy

Please visit our Learning Stream page for our continuing dental education course calendar.

This course has been approved for 1 CDE credit.

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Association for Continuing Dental Education

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2026 SOD RESEARCH DAY GUEST POSTERS

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OHSU Innovates: Supporting the advancement of OHSU research, innovation, and entrepreneurship for the benefit of society

Ronn Leon, Ph.D., Alliance Manager

OHSU Innovates is a collaborative network that supports the innovation and entrepreneurial ecosystems at OHSU and beyond. Services we provide include Evaluation, management and marketing of OHSU innovations and intellectual property, development and implementation of strategies to establish partnerships, commercialization and intellectual property agreement management, Alliance management for strategic partnerships, guidance and assistance for new startup company formation, and entrepreneurial education programs and early-stage technology funding.

Pacific Northwest bioMedical Innovation Co-laboratory

Joshua N. Adkins, Ph.D. and Jason E. McDermott, Ph.D.

The Pacific northwest bioMedical Innovation Co-laboratory (PMedIC) is a research partnership between Oregon Health & Science University (OHSU) and the U.S. Department of Energy's Pacific Northwest National Laboratory (PNNL). PMedIC was established in 2018 to advance patient-specific approaches for diagnosis and clinical care. Since 2018, PMedIC has grown to support collaborations throughout the discovery-to-translation spectrum. More than 50 projects and 100 publications have arisen from PMedIC as of 2025, with many of our investigators forming lasting scientific collaborations. Led by co-directors at each institute, the PMedIC Leadership Team is an initial contact point to facilitate new connections, work through institutional communications, and to aid in advancing your collaborative research and impact. Our mission: Generate, interpret, and integrate high-dimensional, multi-omics data, imaging, and clinical results to gain mechanistic understandings of disease and develop innovative therapies. Our vision: Transform human health through innovative and collaborative research in tandem with the cultivation of a diverse biomedical community.

Atomistic insight in the early stages of amelogenesis and its influence on enamel disorders

Hoshin Kim,1 Sebastian T. Mergelsberg,1 Garry W. Buchko,2 and Bojana Ginovska1 1Physical and Computational Sciences Directorate, Pacific Northwest National Laboratory, Richland, WA 99352, 2Earth and Biological Sciences Directorate, Pacific Northwest National Laboratory, Richland, WA 99352

Amelogenin is an intrinsically disordered enamel protein whose monomeric conformations and self-association are difficult to capture computationally. Using a combination of NMR and SAXS experiments to benchmark all-atomistic simulations of murine rM179 at various pH conditions. The SAXS measurements show a pH-dependent oligomerization, that is extended monomers at pH 3, heterogeneous dimers dominating near pH 5–5.5, coexistence of dimers with higher-order assemblies above pH 5, and nanospheres at pH 8 with a residual dimer fraction. Ser16 phosphorylation modestly stabilizes the dimers. Our studies also find that point mutations T21I and P41T cause decreased dimer stability, increasing the monomer concentrations at all conditions, including pH > 7. We find that pH, phosphorylation and point mutations in amelogenin modulate the aggregation, likely influencing the early nucleation processes that eventually may lead to development of defective enamel.

2026 Research Day

Thursday, March 5
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Session 1 — 8:30AM - 10:00AM

Poster #	Presenter	Co-Authors / Collaborators	Title
DMD Student - CASECat			
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3	Alexandra Drury	Alexandra Drury, Carson Cardwell, Ethan Chung, Janelle Gokim, Ian Foster, Lily Zhoun	A Comparison of the Effectiveness of SMART Versus Traditional Drilling Methods
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21	Braden Petree	Braden Petree and Daniel Kim	Efficacy of Platelet-Derived Scaffolds in Regenerative Endodontic Treatment
47	Catherine Nordstrom	Britney Muralt, Catherine Nordstrom, Anh Nguyen, Alexis Louie	The Use of Curodont Repair Self-Assembling Peptides (P11-4) for Remineralization of Enamel
27	Colin Wong	Colin Wong	Clinical Effectiveness of Platelet-Rich Fibrin in Alveolar Ridge Preservation
5	Diyar Dezay	Diyar Dezay, Despoina Bompolaki	Digital Complete Dentures: The Future of Treating Edentulous Patients Requiring Dentures
49	Ellie Anderson	Ellie Anderson, Anh Nguyen	Oral-Derived Probiotics for Caries and Periodontal Disease Prevention: A Focus on Sustainable Microbial Balance
7	Gabriel Staudinger	Gabe Staudinger, Talon Polk, Jarial Rolon	Antimicrobial Efficacy of Hypochlorous acid (HOCl) in Comparison to Chlorohexidine (CHX)
9	Isabella Sandgren	Isabella Sandgren, Ashlyn Hegar, Skylar Beck	Non-Nutritive Sucking as a Risk Factor for Malocclusion
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35	Jonathan Cha	Jonathan Cha, Bruce Havens	Predictive Value of 3d models in Mitigating Alveolar Bone Defects During Clear Aligner Therapy
11	Katie Duong	Katie Duong, Vesna-Lea Ferrer, Bruce Havens	Orthodontic Treatment and Management for Patients with Autism Spectrum Disorder
39	Khalil Tams	Khalil Tams, Geoffery Khoury, Colby Stevens, Kellen Olsen, Jacob Gurney	AI-Assisted Implant Placement vs Conventional Implant Placement
33	Leland Wong	Leland Wong	Fixation Choice in Le Fort I Fractures: Resorbable Versus Titanium Hardware
17	Noah Pratt	Noah Pratt	Thermal Changes During Dental Implant Osteotomy and Their Impact on Osseointegration
41	Peter Nguyen		Laser Etched Dentin Protocol For Direct Resin Composite Restorations
13	Sarah Audi	Sarah Audi, April Sierra	Magnesium Supplementation and Its Effects on Dental Pain
15	Taylor Carpenter	Taylor Carpenter	Optimizing Use of Marcaine/Bupivicaince in Dental Surgeries
37	Thien Tu	Thien Tu, Kevin Vu	Layered vs Monolithic Lithium Disilicate in Anterior Teeth: Evaluating Esthetic Gains Against Clinical Tradeoffs
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81	Srisankalp Gaddam	Srisankalp Gaddam, Alakananda Melethelil Sreeramadas, Pinaaz Kiran Hode, Pragyan Paramita, Luca Braghetta, Dr. Yabing Chen, Dr. Cristiane Miranda Franca	Glymphatics on a chip
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PhD STUDENT			
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65	Jade Zago	Jade Laísa Gordilio Zago; Fernanda Sandes de Lucena; Fernanda Midori Tsuzuki; Giselle Maria Marchi; Carmem Pfeifer	Development of Acrylamide-Modified Antibacterial Resin Infiltrants Incorporating Nanohydroxyapatite for Enhanced Durability and Biofilm Suppression
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91	Rong Mu	Rong Mu; Stephanie S. Momeni	Role of the Butyrolactone–Ladderane-Like Hybrid Biosynthetic Gene Cluster (BL-BGC) in Streptococcus mutans Virulence
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Does experimental learning in a community clinic change dental students attitudes, and beliefs towards caring for HIV patients

Eloise Ngatia

DMD STUDENT, OHSU SCHOOL OF DENTISTRY

Co- Authors:
Eloise Ngatia, Celyna Becerra, Dr. Foster Page, Dr. Pindyck

Introduction: HIV-related stigma among healthcare providers is an ongoing public health crisis, and dentistry is not an exception. For individuals living with HIV, maintaining good oral health is crucial. This study aimed to examine if stigma and bias exists in the DS4 students at the Oregon Health and Science University School of Dentistry, and whether direct-patient interaction for a week at the Russell Street Dental Clinic (HIV-designated clinic) reduces some of the HIV-related stigma.

Methods: Following IRB approval, dental students' perception of their knowledge and attitudes toward treating HIV+ patients were assessed using the 30-item Healthcare Provider HIV/AIDS Stigma Scale (HPASS) during the 2024/ 2025 academic year. Social demographic data (age, sex, race/ethnicity) was also collected. DS4s filled out the HPASS surveys before and after a one week rotation at a clinic serving HIV patients. Data were analyzed using descriptive statistics, central tendency, and frequency distributions. Internal consistency was tested with Cronbach's alpha. Paired t-tests were used to analyze the follow-up data. Effect sizes were calculated to provide dimensionless measures of effect (<0.2 indicates a small meaningful change, 0.2-0.7 moderate and >0.7 large). Following analysis, a focus group with DS4 students was conducted to explore why there was little change in one of the sub-scales.

Results: Overall, 80.3% of the DS4s who completed the baseline survey, completed the follow-up survey. Slightly more participants were male (57%). The students' race, age, and sex significantly influenced knowledge and attitudes. The overall HPASS score significantly improved from 72.1 to 63.4 post-clinic rotation. Effect sizes varied across domains, with small to moderate effect changes in prejudice and stereotype. However, the discrimination remained relatively unchanged (0.1). Thematic analysis of the focus group identified three major themes.

Conclusion: Overall, the one-week HIV clinic rotation resulted in modest improvements in some attitudes but did not meaningfully reduce stigma across all domains. Persistent discrimination reflects gaps in legal awareness, team-wide HIV knowledge, and early clinical education, highlighting the need for earlier, comprehensive infectious disease training to reduce bias.

Poster #51
Session #1

Category DMD/ Research

Tunneled Coronally Advanced Flap (TCAF): A Hybrid Soft Tissue Approach Combing Tunneling and Coronally Advanced Principles - Technique Review and Case Series

Everett Tran

DMD Student, OHSU School of Dentistry

Co- Authors:
Justin Kim DDS, Nikolaos Soldatos DDS, PhD, MSD

Introduction:
Tunneling[1] techniques and coronally advanced flap (CAF)[2] procedures are widely used for the treatment of gingival recession defects. Tunneling approaches preserve papillary integrity and enhance vascular supply, while the traditional coronally advanced flap technique allows predictable coronal positioning of the marginal tissue. Each method offers unique advantages but also presents limitations when used independently.

Methods:
This poster aims to showcase three surgical cases treated with Tunneled Coronally Advanced Flap (TCAF) technique[3] described by Barootchi & Tavelli (2022) treated at the OHSU Grad Periodontics Clinic. This hybrid technique combines full-thickness tunneling with vertical incision(s) and subsequent coronal advancement of the flap to optimize tissue mobility, graft insertion and positioning, and vascularization of the graft.

Results:
All three cases demonstrated favorable healing with improved root coverage and soft tissue thickness. No significant post-operative complications were noted. Notably, flap reflection and graft maneuvering utilizing this technique were significantly improved compared to traditional tunneling and the coronally advanced flap alone.

Conclusion:

Clinical outcomes from this case series suggest that TCAF may be a reliable option for the surgical management of gingival recession defects by optimizing the principles of both the tunneling and coronally advanced flap techniques.

Poster #29
Session #1

Category DMD/ Research

Identification of sex-dimorphism of temporomandibular joint derived perivascular stromal cell

Grace Oh

DMD STUDENT, OHSU SCHOOL OF DENTISTRY

Temporomandibular joint osteoarthritis (TMJOA) is a debilitating condition marked by progressive osteochondral degeneration of the temporomandibular joint (TMJ). It disproportionately affects middle-aged women, who often experience more severe symptoms; however, the biological mechanisms underlying this sex-specific disparity remain unclear. Perivascular stromal cells (PSCs), which exhibit mesenchymal stem cell (MSC) like properties, have been implicated in the regulation of disease progression. Using the burn synovectomy (BS) mouse model, the first established model to recapitulate TMJOA phenotypes, this study aims to elucidate the role of sex-specific TMJ synovium derived PSCs in mediating sexual dimorphism in TMJOA through comprehensive transcriptomic and histological analyses.

Temporomandibular joint osteoarthritis (TMJOA) is a debilitating condition marked by progressive osteochondral degeneration of the temporomandibular joint (TMJ). It disproportionately affects middle-aged women, who often experience more severe symptoms; however, the biological mechanisms underlying this sex-specific disparity remain unclear. Perivascular stromal cells (PSCs), which exhibit mesenchymal stem cell (MSC) like properties, have been implicated in the regulation of disease progression. Using the burn synovectomy (BS) mouse model, the first established model to recapitulate TMJOA phenotypes, this study aims to elucidate the role of sex-specific TMJ synovium derived PSCs in mediating sexual dimorphism in TMJOA through comprehensive transcriptomic and histological analyses.

Flow cytometry analysis revealed a significantly higher number of PSCs in the TMJ of female mice compared to males. Bulk RNA-seq of TMJ-derived PSCs identified sex-specific differences in signaling pathway activity independent of sex hormone effects. Furthermore, histological, optical, and radiological analyses demonstrated sex-dependent differences in $PdgfrB^{+}$ TMJ-PSC cellular activity, condylar morphology, and angiogenesis patterns.

Our findings reveal sex-specific biological differences in TMJ-derived PSC profiles under both uninjured conditions and during TMJOA progression. These differences may explain the distinct TMJOA phenotypes observed between sexes and highlight the potential for sex-specific therapeutic strategies in the treatment of TMJOA.

Poster #19 **Category** DMD/ Research
Session #1

Identifying OCT-derived Imaging Markers of Tooth Eruption

Graham Kang
DMD Student, Orthodontics and Dentofacial Orthopedics, OHSU School of Dentistry

Co- Authors: Daniel Chen, Graham Kang

Introduction: Traditional monitoring of tooth eruption relies heavily on ionizing radiation techniques such as cone-beam computed tomography (CBCT) and panoramic radiographs. While effective, repeated exposure poses risks, especially in pediatric populations. Optical Coherence Tomography (OCT) offers a non-invasive, high-resolution, radiation-free alternative capable of real-time imaging of soft and hard tissue changes. In this study, we evaluated the potential of a laboratory-developed dental OCT system to identify normal tooth eruption and detect ankylosed teeth, providing insights into the dynamic tissue changes during the eruption process.

Methods: Thirty participants aged 7–13 years were recruited from the Oregon Health & Science University (OHSU) orthodontic and pediatric dentistry clinics. Eligibility criteria included: (1) eruption of the permanent central incisor #1, and (2) presence of a developing permanent canine or permanent premolar beneath the primary canine #C or primary first molar #D from the same side of the dental arch. Tooth eruption was categorized into three stages: stable primary teeth, mobile primary teeth, and fully erupted crowns.
Swept-source OCT with a central wavelength of 1310 nm was used to scan the gingiva apical to the facial marginal ridge of the permanent central incisor and the corresponding primary canine or primary first molar. A 5 × 5 mm^2 region was captured, consisting of 500 B-scans (each containing 500 A-scans, repeated three times). Vessel density, gingival thickness, periosteal integrity, and alveolar bone gradient were quantified and compared across the three eruption stages. A custom-built 1310 nm Swept-Source OCT (SS-OCT) system was employed due to its superior depth of penetration through gingival mucosa and alveolar bone, allowing visualization of sub-surface dental structures. Imaging focused on 5×5 mm^2 regions, with each volume consisting of 500 B-scans (500 A-scans each). Three-fold repeated averaging was applied to maximize signal-to-noise ratio in dense tissue. Both normal erupting teeth and ankylosed teeth were imaged across all subjects, capturing stage-specific tissue and vascular markers associated with the eruption process.

Results: Distinct OCT imaging markers were identified across different eruption stages. Progressive thinning of the alveolar bone, increased angiogenesis, and periosteal condensation were observed during the mobile tooth stage, followed by a reduction in these features after full eruption. Compared to normal teeth, ankylosed teeth exhibited an abnormal fused pattern at the bone-tooth interface that was visualized using SS-OCT.

Conclusions:
This study demonstrates that SS-OCT provides a sensitive, non-invasive method for monitoring tooth eruption, capturing both soft and hard tissue dynamics in vivo. The ability to detect

structural changes offers a potential diagnostic advantage over traditional radiography, particularly for early identification of eruption abnormalities such as ankylosis. These findings highlight the utility of OCT in providing detailed functional and structural information, which may improve understanding of dental development processes.

Exploring Factors Influencing Oregon Dental Professionals' Engagement in HPV Vaccination

Lauren Richards

DMD STUDENT, OHSU SCHOOL OF DENTISTRY

Co- Authors: Lauren Richards, Yifan Zhang, DDS, PhD, MS, Michelle Nguyen, DDS, Danielle Higbee, MPH, Jacy Stauffer, DMD, Wai-Yin Chan, DMD, MS, MPH, Lyndie Foster Page, BDS, PhD

Purpose: The purpose of this study is to understand the challenges and motivators influencing dental professionals' engagement in HPV vaccination advocacy and administration across training stages.

Methods: This qualitative study used the Theoretical Domains Framework (TDF) to examine barriers and facilitators affecting dental providers' HPV advocacy and administration. Focus groups were conducted with first-year dental students (DS1), fourth-year dental students (DS4), pediatric residents, community general dentists, and private practice pediatric dentists. Participants were recruited using purposive sampling from the Oregon Dental Association, Oregon Academy of Pediatric Dentistry, and OHSU School of Dentistry. Semi-structured TDF-based questions guided the discussion. Transcripts were analyzed using directed qualitative content analysis in NVivo, with codes derived from TDF domains.

Results: Across TDF domains, Environment and Knowledge showed the highest coding intensity. Valence patterns differed by group and domain. Community general dentists showed the strongest positive valence in key domains. DS4, pediatric residents, and pediatric dentists showed comparatively stronger negative valence in Environment domain. Knowledge showed substantial positive coding across groups, with DS1 as the only group demonstrating predominantly negative coding. Overall, findings indicate that HPV advocacy and administration behaviors are shaped by domain-specific barriers and facilitators that vary by training stage.

Conclusion: The study identified a range of facilitators and barriers influencing dental providers' engagement in HPV vaccine advocacy and administration. Targeted interventions addressing multiple TDF domains—particularly knowledge, skills, environmental context, and social influences—may strengthen dental providers' capacity to engage meaningfully in HPV vaccine advocacy and delivery.

Poster #53 **Category** DMD/ Research
Session #1

Optimizing Fixation Protocols for Biofilm Formation on Dental Materials

Tanya Aftab

DMD STUDENT, BIOMATERIAL AND BIOMEDICAL SCIENCES, OHSU SCHOOL OF DENTISTRY

Co- Authors:
Tanya Aftab, Sivashankari Rajasekaran, Krishna Kungumaraj, Ana P. Fugolin

The dental materials industry continues to evolve with the development of restorative materials designed to improve functionality and aesthetics. Among these advances, the incorporation of antimicrobial properties has gained significant attention due to the limited clinical longevity of resin-based restorations caused by secondary caries. Reliable in vitro assessment of antimicrobial activity is therefore essential during material development. While metabolic assays are commonly used, microscopy-based biofilm analyses, often combined with image processing and machine-learning tools, are increasingly applied to provide structural insights. However, the influence of biofilm fixation protocols on scanning electron microscopy (SEM) image quality and quantitative analysis remains poorly understood. This study compared four biofilm fixation protocols for SEM imaging and evaluated their compatibility with Fiji-based image analysis, while introducing a complementary approach for SEM biofilm cross-sectional analysis. Resin composite discs (10 x 2 mm) were characterized for degree of conversion and surface roughness and incubated with Streptococcus mutans (renillareporter strain) for 1h and 24h. Metabolic activity was assessed using a luciferase assay. Biofilms were fixed using protocols based on buffered formalin and/or glutaraldehyde, with or without graded ethanol dehydration, prior to SEM imaging. In parallel, resin bars were used for cross-sectional biofilm evaluation. Quantitative image analysis was performed using Fiji with Trainable Weka Segmentation, and data were analyzed using ANOVA with Tukey's post hoc test ($p < 0.05$). Biofilm fixation protocols significantly affected SEM image quality, biofilm architecture, and quantitative measurements. Glutaraldehyde fixation combined with graded ethanol dehydration produced superior image resolution, enabling clearer discrimination among bacterial cells, extracellular matrix, and material surfaces, and enhanced detection of architectural differences, particularly in biofilm cross-sections. These findings highlight the importance of standardized fixation protocols and support a multimodal framework integrating metabolic, surface, and cross-sectional analyses for robust in vitro evaluation of antimicrobial dental materials.

Poster #55 **Category** DMD/ Research
Session #1

The Influence of Municipal Fluoridation Policy on Caregiver Preventive Behaviors: A Cross-Sectional Study of OHSU Pediatric Dental Patients

Esther Gao

PEDIATRIC DENTISTRY, OHSU SCHOOL OF DENTISTRY

Co- Authors:
Esther Gao, DDS, RD, MPH; Gulaiim Almatkyzy, PhD; Richie Kohli, BDS, MS; Elizabeth A Palmer, DMD, MS; Donald Chi, DDS, PhD

Purpose and Hypothesis
Improving oral health outcomes remains a priority in Oregon. Understanding parents' attitudes toward preventive measures can dictate community recommendations. This study evaluates the relationship between household water fluoridation (HWF) status and caregiver attitudes and behaviors regarding pediatric fluoride. It is recommended that dental professionals monitor a child's overall fluoride exposure. We investigate how HWF correlates with fluoride hesitancy and whether sociodemographic factors—including income, education, and age—influence the likelihood a child receives professional fluoride treatment. We hypothesize that families in non-fluoridated areas will exhibit higher hesitancy and that sociodemographic factors influence the association between the HWF and receiving fluoride.

Methods
This exploratory cross-sectional study utilized a caregiver survey administered via REDCap to caregivers of pediatric patients at the Oregon Health & Science University (OHSU) Pediatric Dentistry Clinic (n=98). The primary independent variable was household water fluoridation (HWF) status, determined by mapping participant residential addresses to municipal water reports in Oregon and Washington. Dependent variables included a validated fluoride hesitancy score (scale 0–3) and the application of professional topical fluoride. sociodemographic covariates—caregiver age, gender, education level, race, ethnicity, and household annual income—were collected to assess moderation effects. Income was categorized by income brackets, and education was grouped into three tiers (high school or less, some college, and 4-year degree or higher). An independent T test was used to compare mean hesitancy scores between fluoridated and non-fluoridated cohorts. A bivariate analysis was used to calculate the sociodemographic characteristics against the receipt of fluoride treatment. A subgroup analysis assessed statistical interaction of household fluoridation status on treatment likelihood differed significantly across socioeconomic strata.

Results
Our first aim analyzed fluoride hesitancy against five domains. Lower scores indicated lower hesitancy. Caregiver fluoride hesitancy scores were similar between fluoridated and non-fluoridated HWF. The only significant difference was observed in Domain 4, indicating higher uncertainty about topical fluoride science among caregivers in fluoridated communities compared with caregivers in non-fluoridated communities (mean 1.37 vs 1.03; p = 0.049). Domain 5 also

showed a trend toward higher hesitancy in fluoridated communities, but it did not reach statistical significance (p = 0.06).

Our second aim assessed sociodemographic characteristics of caregivers and whether their child received professional fluoride applications. While most factors showed no significant difference between fluoridation status, there was a statistical significance between household income and receiving professional fluoride treatment (p=0.02). Families with lower income were correlated with refusing professional fluoride treatment.

Conclusions

In summary, this study demonstrates that while household water fluoridation (HWF) status does not significantly impact overall fluoride hesitancy or clinical utilization, it is associated with specific barriers. Caregivers in fluoridated households reported significantly higher uncertainty regarding topical fluoride science. Furthermore, household income emerged as a critical predictor for declining professional applications. While well-matched demographics and use of a validated questionnaire strengthen these findings, the small sample size limits generalizability. Future interventions should prioritize targeted education and financial accessibility to improve pediatric preventive care.

Histologic evaluation of alveolar ridge preservation using aseptically processed large-particle DFDBA

Marjan Ghaffarinia
RESIDENT, OHSU SCHOOL OF DENTISTRY

Abstract not available

Poster #59
Session #1

Category RESIDENT

Oral Health and Pain in Pediatric Dental Patients

Shelby Cansler

PEDIATRIC DENTISTRY, OHSU SCHOOL OF DENTISTRY

Co- Authors:
Shelby Cansler, DDS[1], Jessica Heierle, MBA[2], Aaron Mauch[2], Amy Holley, PhD[2], Elizabeth A Palmer, MS, DMD[1]

OHSU 1 Division of Pediatric Dentistry, School of Dentistry; 2 Division of Psychology, Department of Pediatrics, School of Medicine

Introduction
Pediatric dental pain assessment is complicated by a disconnect between clinical pathology and subjective experience. This study evaluated the relationships between caries severity, caregiver-reported child pain, and pain-related symptomatology. We assessed associations between caries severity and child dental pain while examining how general anesthesia recommendations relate to caregiver stress. We hypothesized that: 1) caregivers with personal pain would report higher child pain and stress; 2) increased caries severity would correlate with higher child pain and decreased function; and 3) caregivers of children recommended for general anesthesia would report elevated stress and higher perceived child pain levels.

Methods
This retrospective study included 50 caregiver-child dyads presenting with dental pain to the Oregon Health & Science University (OHSU) Pediatric Dental Clinic. Caregivers completed surveys via REDCap assessing demographics, personal pain history, stress related to their child's dental condition, child pain intensity (0-10 NRS) and pain-related symptomatology using the Pediatric Pain Screening Tool (PPST). Patient charts were manually reviewed to extract relevant clinical data, which were then entered into REDCap. Extracted variables included radiographic caries extent, treatment modality (general anesthesia yes/no), and other clinical data such as the presence of soft tissue pathology, clinical caries, facial swelling, fever, history of trauma, and oral hygiene status. Descriptive statistics summarized the cohort, and Pearson correlations and independent sample t-tests were used to test aims. Statistical significance was defined as $p < 0.05$.

Results
Fifty caregivers participated (80% females), and their mean stress level due to their child's dental pain was M=4.88 (SD=2.9). The mean caregiver report of child's pain intensity was M=4.06 (SD=2.7). Analysis revealed a strong correlation between caregiver-reported child pain intensity, caregiver stress ($r=6.33$, $p<.001$) and PPST scores ($r=.518$, $p<.001$). Contrary to hypotheses, clinical caries severity showed no association with caregiver reported child pain intensity or PPST score. Caregiver pain was not associated with caregiver stress regarding their children's dental pain nor report of child pain intensity. In support of hypotheses, caregivers whose children planned to receive dental treatment under general anesthesia reported significantly higher stress than those in the non-general anesthesia group [$t(48)=-3.06$, $p=.004$]. Associations among general anesthesia (yes/no) and PPST score approached significance [$t(43)=-1.62$, $p=.056$]. There were no significant

differences in the caregiver-reported pain intensity in youth planned for versus not planned for general anesthesia.

Conclusion

Findings point to significant associations between caregiver stress and child pain-related symptomatology. Caregivers reporting higher stress regarding their child's pain also reported increased pain intensity and functional interference. Furthermore, recommendations for general anesthesia were strongly associated with elevated caregiver stress, suggesting that screening this group is clinically vital. A notable diagnostic discordance exists, as clinical caries severity did not correlate with subjective pain reports, proving that visual and radiographic exams alone are insufficient. Future research should continue to identify caregiver factors associated with child outcomes in the pediatric dental setting to better inform shared decision-making and identify specific intervention targets.

Engineering lymphatic vessel on a chip

Alakananda Melethil Sreeramadas

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Co- Authors:
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Introduction: During fibrosis, the extracellular matrix (ECM) undergoes major compositional and structural remodeling that alters cell behavior and tissue function. Lymphatic vessels, which regulate fluid and immune cell transport, are sensitive to these changes and frequently exhibit dysfunction in fibrotic tissues. However, how fibrotic matrix architecture and stiffness regulate lymphatic endothelial cell behavior remains poorly defined, in part due to the lack of physiologically relevant in vitro models that enable controlled lymphatic-ECM interactions. We hypothesized that matrix stiffness modulates junctional organization and sprouting dynamics through mechanosensitive responses. This study aimed to engineer a microfluidic lymphatic vessel-on-a-chip to evaluate how ECM stiffness influences lymphatic endothelial structure and sprouting.

Methods: Microfluidic devices were designed in Autodesk Fusion with a central gel chamber perfused by two parallel channels (160 µm wide, 1 mm apart). Resin molds were 3D-printed, followed by PDMS casting, curing at 60°C, plasma bonding to glass coverslips, and autoclaving. The central chamber was treated with 1% glutaraldehyde to enhance collagen attachment. Acupuncture needles were inserted to define channels, and type I rat-tail collagen (2.5 mg/mL) was polymerized overnight under two conditions to generate distinct mechanical microenvironments: soft reticular collagen (healthy-like) and stiff bundled collagen (fibrotic-like). After 24 h, needles were removed to create hollow channels that were perfused with cell culture media. Primary human lymphatic endothelial cells were seeded (5×10^6 cells/mL) to form engineered lymphatic vessels. After 48 h, lymphatic drainage was assessed using 70 kDa dextran perfusion. Immunofluorescence staining for actin and CD31 was used to evaluate endothelial morphology, cell-cell junctions, and sprouting by confocal microscopy. Sprout length and density were quantified using Fiji and Imaris. Statistical comparisons were performed using Student t-tests.

Results: Lymphatic vessels formed in both matrix conditions. Vessels in soft reticular matrices formed continuous, branched networks with lower sprouting density. In contrast, stiff bundled matrices induced increased sprouting, with significantly longer sprouts.

Conclusions: ECM stiffness influences lymphatic endothelial morphology and sprouting behavior. This lymphatic vessel-on-a-chip provides a controllable platform to study lymphatic-ECM interactions under defined mechanical conditions.

Poster #63 **Category** PhD STUDENT
Session #1

Development of matrix metalloproteinase-9 responsive coumarin-loaded nanomicelles for the treatment of cutaneous leishmaniasis

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Abstract not available

Poster #67
Session #1

Category - PhD Student

Development of Acrylamide-Modified Antibacterial Resin Infiltrants Incorporating Nanohydroxyapatite for Enhanced Durability and Biofilm Suppression

Jade Zago
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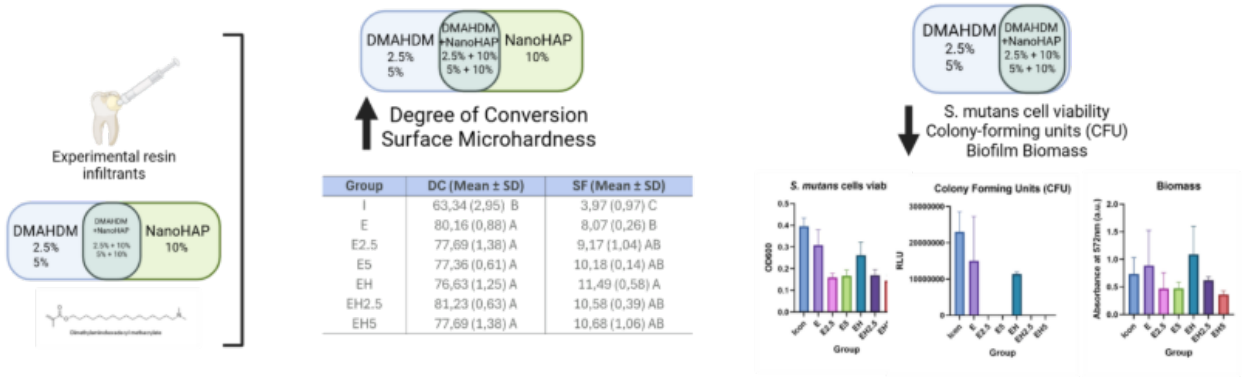
Introduction: Non-cavitated enamel lesions represent a critical stage of the caries process in which timely intervention can limit lesion progression while preserving tooth structure. However, currently available resin infiltrants primarily provide mechanical sealing and lack intrinsic antibacterial and remineralizing functionality, which may compromise long-term clinical effectiveness. Therefore, the aim of this study was to develop and evaluate experimental resin infiltrants incorporating the antibacterial monomer dimethylaminohexadecyl methacrylate (DMAHDM) and nanohydroxyapatite as a multifunctional strategy for the management of early caries lesions.

Methods: Seven groups were evaluated: commercial control Icon™ (DMG®); experimental control (E) consisting of 75% triethylene glycol dimethacrylate (TEGDMA), 25% urethane dimethacrylate (UDMA), 0.5% camphorquinone, and 1% ethyl 4-(dimethylamino)benzoate (EDMAB); E2.5 (E + 2.5% DMAHDM); E5 (E + 5% DMAHDM); EH (E + 10% nanohydroxyapatite); EH2.5 (E + 10% nanohydroxyapatite + 2.5% DMAHDM); and EH5 (E + 10% nanohydroxyapatite + 5% DMAHDM). Disc-shaped specimens (5 mm diameter) were prepared for degree of conversion (DC) analysis (n = 6) using Fourier transform infrared spectroscopy (FTIR). Surface microhardness (SM) was measured (n = 6) using a 50 kgf load applied for 5 s. Antibacterial activity against Streptococcus mutans biofilms was assessed by colony-forming unit (CFU) counts (n = 3), biofilm biomass (n = 6), and planktonic bacterial activity (n = 6) using non-solvated formulations. Viscosity was measured using a rheometer (n=3, 70 µL per specimen). Data were analyzed using one-way ANOVA followed by Tukey's test (α = 5%).

Results: All experimental infiltrants demonstrated higher DC than the commercial control Icon™ ($p<0.001$), indicating adequate polymerization performance of the experimental formulations. Formulations containing nanohydroxyapatite showed the highest SM values ($p<0.001$), suggesting improved mechanical reinforcement of the infiltrates substrate (Figure 1). DMAHDM resulted in significant reductions in S.mutans CFU ($p<0.001$), biofilm biomass ($p=0.005$), and planktonic bacterial activity ($p<0.001$) in all groups, demonstrating effective antibiofilm functionality (Figure 1).

Poster #65
Session #1

Category PhD STUDENT



Group	DC (Mean ± SD)	SF (Mean ± SD)
I	63,34 (2,95) B	3,97 (0,97) C
E	80,16 (0,88) A	8,07 (0,26) B
E2.5	77,69 (1,38) A	9,17 (1,04) AB
E5	77,36 (0,61) A	10,18 (0,14) AB
EH	76,63 (1,25) A	11,49 (0,58) A
EH2.5	81,23 (0,63) A	10,58 (0,39) AB
EH5	77,69 (1,38) A	10,68 (1,06) AB

Figure1. Graphical abstract illustrating the results of degree of conversion (DC), surface microhardness (SM), and antibiofilm activity.

Conclusion: Experimental resin incorporating DMAHDM provided effective antibiofilm activity, while the addition of nanohydroxyapatite increased surface microhardness. These findings demonstrate the translational potential of multifunctional infiltrant formulations as a minimally invasive strategy to improve the clinical management and durability of treatments for non-cavitated caries lesions.

Poster #65
Session #1

Category PhD STUDENT

A Protein Crosslinking Method to Assess the Potential for Kidney Stone Formation

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Introduction: Kidney stones (Nephrolithiasis) are primarily composed of calcium phosphates and oxalates. Stone formation is linked to the presence and behavior of urinary proteins, which generally act as aggregation inhibitors, but when urine becomes supersaturated, these proteins switch to promoters of aggregation. These proteins may act as nucleators of mineral aggregation, influencing precipitation of calcium oxalate or phosphate crystals. In this work a protein crosslinking method was tested and applied to urine protein specimens from Stone-Forming (SF) and Non-Stone Forming (NSF) populations. A proof-of-concept model was developed and validated using albumin and EDC/NHS coupling chemistry to quantify the amount of crosslinking.

Methods: To perform this study urine samples were collected from SF and NSF populations. First the EDC/NHS crosslinking chemistry was tested on albumin in phosphate buffer solution. Dynamic Light Scattering analysis (DLS) was conducted on the untreated and EDC/NHS-treated albumin. Next SF and NSF specimens were lyophilized, weighed and the same experimental steps were repeated. Urinary proteins were crosslinked with EDC/NHS to produce stable aggregates and were quantified using DLS. Particle size (Z-average) data (n=12) was analyzed with a one-way ANOVA/Tukey's test (α=0.05).

Results: Comparative results indicated crosslinking/aggregation of albumin proteins, demonstrated by a shift in the intensity vs size plot, validating the crosslinking method. Z-Average increased in all SF and NSF specimens after crosslinking. The SF group demonstrated a statistically significant increase in Z-Average from 274.7±114.4 nm to 726.2±226.4 nm ($p < 0.01$). The Z-Average for the NSF groups increased from 557.4±351.6 nm to 685.9±183.0 nm after crosslinking but was not statistically significant ($p = 0.52$). This may suggest that certain proteins in SF populations have a greater influence in modulating mineral aggregation, despite a smaller initial average particle size.

Conclusions: This technique has promising translational potential, as future work includes the development of a clinical diagnostic tool to rapidly differentiate the SF and NSF populations. Dental applications are also being pursued, including nanoparticle-to-protein conjugation for disruption of dysbiotic oral biofilms.

Poster #69 **Category** POSTDOC
Session #1

A Human Microphysiological Suture-on-a-Chip for Studying Craniofacial Mechanobiology

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Introduction: Craniofacial sutures are highly adaptive, mechanoresponsive structures that integrate biochemical and mechanical cues to regulate skull morphogenesis and homeostasis. Mechanical forces applied at the tissue and organ scale are transduced through mineralized bone into the suture mesenchyme, where they are sensed by resident cells, encoded via intracellular signaling and transcriptional programs, and translated into matrix remodeling and bone turnover. These cellular responses, in turn, reshape the local mechanical environment, dynamically altering how subsequent forces are perceived. Despite the clinical relevance of these processes in craniosynostosis, facial growth, and regenerative repair, fundamental questions surrounding suture pathophysiology and stem cell mechanobiology remain unresolved, in part due to the limitations of animal models and the absence of dynamic, human-relevant *in vitro* systems. Currently, no platform enables real-time, mechanistic interrogation of this feedback-driven biology under defined mechanical conditions. **Here, we present a human suture-on-a-chip, a microphysiological organ-on-chip model that recapitulates the bilateral, intramembranous growth zone characteristic of cranial sutures and enables direct study of force transmission and cellular mechanobiology.**

Methods: The microfluidic device incorporates spatially organized mineralized bone and mesenchymal compartments and is fabricated from PDMS bonded to glass coverslips, permitting longitudinal live imaging and extraction of engineered tissue for off-chip analyses. The model is built using human fetal osteoblasts, craniofacial fibroblasts, and mesenchymal stem cells (MSCs) in a defined, stepwise sequence. First, opposing mineralized bone channels are created via biomimetic intrafibrillar mineral deposition within osteoblast-laden type I collagen, approximating the bone surfaces of an abutting cranial suture. Following three days of mineralization and osteocyte maturation, osteoblasts are layered onto the mineralized interfaces, and a low-density collagen matrix containing fibroblasts, osteoblasts, and MSCs is introduced to form the central suture mesenchyme.

Results: Across multiple timepoints, immunofluorescent and histochemical analyses confirm that the suture-on-a-chip phenocopies key architectural and cellular features of native cranial sutures. Integration of pneumatic actuation enables mechanical perturbation of the system, eliciting measurable cellular responses to subtle shifts in the local force landscape – reflecting a core functional property of craniofacial sutures. The system also supports osteoclast differentiation on mineralized bone surfaces without exogenous growth factors, enabling future investigation of force-regulated bone remodeling and disease-relevant signaling programs within a human suture context.

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Conclusions: Together, this human suture-on-a-chip functions as a tunable mechanoreactor for probing the dynamic, multiscale feedback between mechanical forces, cellular decision-making, and tissue remodeling, with direct relevance to development, disease, and regenerative therapeutics.

Biofunctionalization of Polymeric Nanogels through Peptide Conjugation for Interfacial Modulation in Dental Materials

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Introduction: Polymeric nanogels have been investigated in dental restorative systems primarily as reinforcing or functional additives. However, their use as platforms for covalent peptide conjugation to enable targeted biofunctionalization remains largely unexplored. Therefore, this study aimed to demonstrate methacrylic acid functionalization of a crosslinked nanogel and to validate its suitability for covalent biomolecule conjugation using a tyrosine-based tripeptide as a proof of concept.

Methods: A lightly crosslinked polymeric nanogel composed of urethane dimethacrylate (UDMA, 30 mol%), isobornyl methacrylate (IBMA, 50 mol%), and methacrylic acid (MAA, 0 mol% – control, or 20 mol%) was synthesized. Both nanogels were dispersed in anhydrous N,N-dimethylformamide (DMF) and subjected to carbodiimide-mediated coupling with a tyrosine-based tripeptide (YYY). The resulting materials were purified by precipitation in deionized water, washed to remove residual reagents, and vacuum-dried prior to characterization. Nanogel size distribution and colloidal behavior were evaluated by dynamic light scattering (DLS), while chemical modification was assessed by attenuated total reflectance Fourier-transform infrared spectroscopy (ATR-FTIR) and nuclear magnetic resonance (NMR) spectroscopy.

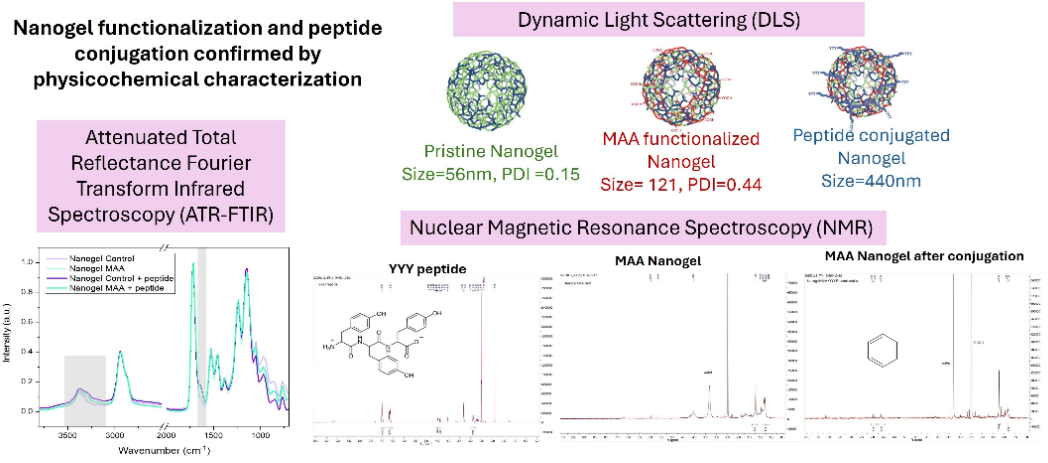

Figure. Evidence of nanogel functionalization and peptide conjugation. DLS analysis showed progressive increases in hydrodynamic diameter from pristine nanogel (56 nm) to MAA-functionalized nanogel (121 nm) and peptide-conjugated nanogel (440 nm), indicating surface modification and altered interparticle interactions. ATR-FTIR spectra revealed increased O–H and amide bands, and NMR detected aromatic tyrosine signals (6.6–7.2 ppm), collectively confirming successful covalent attachment of the YYY peptide to the nanogel network.

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Category POSTDOC

Results: Nanogel functionalization resulted in progressive changes in particle size distribution and characteristic spectroscopic signatures detected by FTIR and NMR, as summarized in Figure.

Conclusion: Peptide conjugation to the polymeric nanogel was successfully achieved through carbodiimide-mediated coupling, as supported by complementary physicochemical characterization. The confirmed incorporation of the YYY peptide demonstrates the feasibility of engineering nanogel surface chemistry to introduce biologically active functionalities. This functionalization strategy establishes a chemical framework for subsequent conjugation of bioactive peptides intended to selectively promote colonization by commensal oral bacteria, such as AbpA derived motifs targeting *Streptococcus gordonii*, supporting the design of biofunctional nanogel based dental polymer systems.

Funding: NIH-NIDCR R35-DE029083 and Silver Family Foundation (Faculty Excellence Award)

The Streptococcus mutans FakB system exhibits unique functional partitioning of fatty acid utilization

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Streptococcus mutans is a major etiologic agent of dental caries, the most common chronic infectious disease worldwide. The bacterial fatty acid biosynthesis pathway is an attractive target for the development of novel antibiotics, however other *Streptococcus* spp. are able to circumvent these therapeutics by scavenging fatty acids from the environment through the fatty acid kinase (Fak) system. The Fak system differs among streptococci, and is poorly understood outside of *S. pneumoniae*. Phylogenetic analysis performed in this study indicated that *S. mutans* has a unique repertoire of 3 FakB paralogs which are different from those present in *S. pneumoniae*, where the Fak system was previously characterized. *S. mutans* encodes *fakB1*, *fakB2*, and *fakB4* paralogs while *S. pneumoniae* encodes *fakB1*, *fakB2*, and *fakB3* paralogs. Unlike *S. pneumoniae*, *S. mutans* could utilize exogenous polyunsaturated fatty acids through FakB2, without encoding a paralog of FakB3. The *S. mutans* FakB2 was quite versatile, being able to use saturated, monounsaturated, or polyunsaturated fatty acids. Meanwhile, *S. mutans fakB4* (with no paralog in *S. pneumoniae*) was induced by unsaturated fatty acids and could sequester potentially toxic intracellular unsaturated fatty acids. Together, these findings support a model in which functional partitioning among FakB paralogs enables *S. mutans* to balance fatty acid utilization with protection against unsaturated fatty acid toxicity. These results also highlight species-to-species differences in the physiology of fatty acid utilization among streptococci, opening the door to therapeutic strategies that exploit these differences, such as novel prebiotics or antibiotics.

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Session #1

Modeling Oral Cancer Bone Invasion Using a High-Fidelity Bone-on-a-Chip Platform

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Introduction: Bone homeostasis relies on tightly coordinated interactions among osteocytes, osteoblasts, osteoclasts, and immune cells within a spatially organized and mineralized microenvironment. However, faithfully reproducing this multicellular interplay in vitro has remained elusive, particularly without the use of supraphysiological exogenous growth factors. Reconstituting the architectural and biochemical cues that regulate osteoclastogenesis and bone resorption is especially challenging, limiting our ability to model pathological processes such as oral squamous cell carcinoma (OSCC) bone invasion. We hypothesized that engineering a biomimetic bone niche that replicates native collagen nanostructure and intrafibrillar mineralization, while supporting three-dimensional osteocyte embedding, would be sufficient to drive functional osteoclastogenesis in the absence of exogenous RANKL/M-CSF and enable physiologically relevant modeling of OSCC bone invasion on-a-chip.

Methods: We developed a biomimetic bone-on-a-chip platform by encapsulating primary human osteoblasts within densely mineralized collagen matrices (2.5 mg/mL) generated using a three-day intrafibrillar nanoscale mineralization protocol. THP-1–derived macrophages or primary peripheral blood mononuclear cell–derived precursors (IRB#18048) were introduced onto the mineralized matrix to establish a multicellular system containing osteocytes, osteoblasts, osteoclast-lineage cells, and macrophages, recapitulating key cellular components of native bone. Osteoblast-to-osteocyte differentiation was evaluated by immunofluorescence, while osteocyte-derived paracrine factors were quantified using Luminex assays. Gene expression changes during osteoclastogenesis were assessed using nCounter Nanostring and compared to non-mineralized controls supplemented with RANKL/M-CSF. Functional osteoclast activity and therapeutic responsiveness were evaluated following treatment with denosumab or alendronate. To model tumor–bone interactions, OSCC cells (UCSF-OT-1109; 3×10^3 cells) were introduced into a lateral microchannel, and invasion into the mineralized matrix was quantified at 24 and 48 hours by cytokeratin immunostaining.

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Results: We demonstrate that the mineralized microenvironment alone induces osteocyte differentiation without exogenous growth factors, as evidenced by increased sclerostin and podoplanin expression. Osteocyte-driven paracrine signaling promoted robust osteoclastogenesis, yielding significantly more multinucleated, TRAP-positive osteoclasts ($p < 0.01$) compared to RANKL/M-CSF–treated controls, both in cell line–derived and primary cell conditions. Mineralized matrices enhanced RANKL expression and reduced OPG levels, whereas RANKL/M-CSF supplementation preferentially upregulated inflammatory mediators such as IL-1β. Transcriptomic profiling revealed that biomimetic matrix–driven osteoclastogenesis was governed primarily by cell–matrix interactions, while growth factor–induced differentiation activated inflammatory signaling pathways. Importantly, the chip recapitulated clinically relevant responses to denosumab and alendronate. In tumor invasion assays, cytokeratin-positive OSCC cells were significantly increased in osteoclast-containing groups relative to non-osteoclast conditions, highlighting the functional contribution of osteoclasts to bone invasion dynamics.

Conclusion: This biomimetic bone-on-a-chip platform recapitulates key structural and functional aspects of human bone with high fidelity and enables growth factor–free osteocyte differentiation and osteoclastogenesis. By integrating tumor–bone interactions and therapeutic responsiveness, the system provides a physiologically relevant platform for studying bone pathology and evaluating targeted interventions in oral cancer.

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Session #1

A Multifunctional Injectable Hydrogel with Antimicrobial and Anti-Inflammatory Properties for Chronic Periodontal Disease

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Introduction: Chronic inflammatory diseases are responsible for the death of nearly three out of five people worldwide, with periodontal disease (PD) ranking among the most prevalent conditions. PD arises from bacterial biofilms that induce a dysregulated host immune response, leading to progressive destruction of periodontal tissues. Recent evidence highlights the critical role of cell-free DNA (cfDNA) originating from bacteria or host cells in sustaining inflammation by Toll-like receptor 9 activation and downstream of NF-κB mediated cytokine release. In an unprecedented approach, this study aimed to develop an injectable multifunctional crosslinked hydrogel capable of simultaneously targeting bacterial biofilms and scavenging cfDNA within the periodontal pocket.

Methods & Materials: An amino-terminated quaternary ammonium compound with a C16 backbone (Q-16) and a 4-arm PEG-alkynoate (PEG-Alk) were synthesized to develop a crosslinked hydrogel (**PEG/Q-16**) at a 1:1.5 molar ratio. The hydrogel formation and β-amino acrylate bond generation were confirmed by rheological testing, ^{1}H-NMR, and FT-IR (n=3). Microstructure was evaluated by scanning electron microscopy (SEM), while swelling behavior and pH-dependent degradation (pH 7.4 and 5.0, 37°C) were assessed by monitoring weight and volume changes during PBS incubation (n=3). Conditioned media antimicrobial activity against *Streptococcus mutans* and *Porphyromonas gingivalis* was assessed by OD600 and luciferase assay (n=6). cfDNA scavenging capacity was quantified using PicoGreen with calf thymus, lambda, and salivary DNA (n=5). Biocompatibility with human gingival fibroblasts was evaluated by Alamar Blue assay, and TLR-9 modulation was assessed using HEK-Blue™ hTLR9 reporter cells. Data were analyzed by one-way ANOVA with Tukey's post hoc test (α=0.05).

Results: Q-16 exhibited a strong positive surface charge (+67.4 ± 1.7 mV) and high cfDNA binding efficiency (~93-94% for calf-thymus and lambda DNA; 63-75% in saliva), along with potent antibacterial activity against *S. mutans* (~99% inhibition) and *P. gingivalis* (up to 90%). Q-16 was crosslinked with PEG-Alk via a dynamic amino-yne click reaction to form an injectable, pH-responsive PEG/Q-16 hydrogel with a porous 3D structure (31.7 ± 11.5 μm). Rheological analysis confirmed stable viscoelastic and shear-thinning behavior, supporting injectability and mechanical stability (3.86 ± 0.88 kPa), as well as self-healing properties. The hydrogel showed accelerated degradation under acidic conditions and sustained antimicrobial and DNA-scavenging activity over 7 days. Transient cytotoxicity was observed on day 1, with recovery by days 4 and 7. Additionally,

conditioned media reduced TLR-9 activation by up to 43%, indicating immunomodulatory potential.

Conclusion: In this study, we developed a multifunctional hydrogel based on dynamic amino-yne chemistry by repurposing a novel quaternary ammonium compound (Q16) as both an antimicrobial and cfDNA-scavenging agent. The resulting PEG/Q16 hydrogel exhibited injectability, self-healing, pH responsiveness, hydrolytic degradability, and biocompatibility. It demonstrated potent antibacterial activity against *Streptococcus mutans* and *Porphyromonas gingivalis* while remaining cytocompatible with human gingival fibroblasts. Importantly, the hydrogel effectively bound cfDNA and reduced TLR-9 activation, indicating immunomodulatory potential. These findings support PEG/Q16 as a promising local therapeutic for periodontitis, combining antimicrobial and anti-inflammatory mechanisms, with potential applications in other inflammation-associated infections.

A New Method for Assessing Healing Efficiency of Poly(Urea-Formaldehyde) Microcapsule-Modified Polymers

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Introduction - Resin composite fractures remains as one of the primary causes of dental restoration failure, typically originating from the accumulation and propagation of microcracks under cyclic thermal and masticatory stresses. While self-healing dental polymers have been developed to mitigate this, traditional *in vitro* evaluation methods, such as fracture toughness testing, rely on monotonic loading until catastrophic failure. These methods fail to replicate the sub-critical crack growth observed in clinical environments. This study proposes a novel methodology for quantifying healing efficiency using Dynamic Mechanical Analysis (DMA) to monitor controlled microcrack formation and assess healing efficiency.

Methods - PUF (poly-urea formaldehyde) microcapsules without or with melamine-modification at 5% (PUMF), were synthesized via a double emulsion reaction using mechanical stirring at 400 rpm. Microcapsules were loaded with a healing agent mixture of either 100% triethylene glycol dimethacrylate (TEGDMA) or an 80:20 wt% blend of TEGDMA and N,N-Dimethylacrylamide (DMAM), both utilizing N,N-Bis(2-hydroxyethyl)-p-toluidine (DHEPT) as a chemical catalyst. Synthesized microcapsules were characterized by optical microscopy, scanning electron microscopy (SEM), and zeta potential. To analyze their micromechanical properties, nanoindentation was performed (n=3). The size distribution of microcapsules was analyzed using ImageJ (n=100). Microcapsules were incorporated at 10 wt% into a resin composite formulation consisting of bisphenol A-glycidyl methacrylate (BisGMA), ethoxylated bisphenol-A dimethacrylate (BisEMA), urethane dimethacrylate (UDMA), and TEGDMA in a 2:2:2:1 weight ratio, along with 50 wt% barium inorganic particles. Benzoyl peroxide (BPO) and phenylbis (2,4,6-trimethylbenzoyl)phosphine oxide (BAPO) were used as chemical initiator for the healing agent and photoinitiator for the composite, respectively. Resin composite bars (0.8 x 3.0 x 25 mm) with a center notch of 1.5 mm were prepared in a silicone mold and photocured with LED light (1198 mW/cm^2). Microcracks were induced in resin bars in three cycles (60 min, 37°C) by applying the minimum strain required to generate a microcrack during dynamic mechanical analysis (n = 3). Bars were imaged by optical microscopy to track crack propagation. Healing efficiency was calculated by monitoring stiffness recovery and crack length across cycles, normalizing values from cycles 2 and 3 against cycle 1. Data were analyzed using two-way ANOVA and Tukey's test.

Results - Microcapsules of well-defined morphology and high stability were successfully synthesized. Nanoindentation revealed a reduction of plastic deformation in DMAM-modified microcapsules from 56.64% to 49.36% in PUF groups and 66.42% to 42.79% in PUMF groups, suggesting that DMAM addition increases elastic behavior in polymer shells. An increase in elastic modulus was also observed in 100T capsules, ranging from 1.4 to 6.1 GPa, compared to 1.3 to 2.6 GPa in 80T/20D capsules, indicating higher stiffness and plasticity. Microcrack induction in

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microcapsule-loaded bars showed successful slowing of crack propagation and mitigation of catastrophic fracture, as compared to bars without microcapsules. Negative controls exhibited extensive crack propagation and, in most samples, catastrophic failure by the second loading cycle. Capsule-loaded groups exhibited lower overall stiffness but retained stiffness throughout crack propagation, whereas the negative control lost stiffness in subsequent loading cycles. Healing efficiencies for capsule-loaded groups ranged from 82.1 ± 8.5% to 110.3 ± 21.5%.

Conclusion - The addition of additive-modified microcapsules proved to be a promising approach for increasing the stability of resin composites following the formation of microcracks, possibly by redistributing stress through the polymer network. The newly developed method for assessing healing efficiency demonstrated accurate reproduction of microcrack formation and propagation commonly seen in clinical examples of restoration failure. In the future, this may be used to more accurately assess the material properties of modified resin composites.

Using click chemistry as a high-throughput approach to functionalize FAST fluorogens

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Co- Authors:

David Anderson, Hongbo Zheng, Tiancheng Ma, Matthew Logan, Sarah Patty, Carmem Pfiefer, K. Barry Sharpless, JiaJia Dong, and Justin Merritt

Introduction: This work aims to combine the power of click-based chemistry with high-throughput chemical screening of functionalized fluorogen reporters. Recent breakthroughs in library synthesis technology have opened the door to making bespoke fluorogen chemistries on the scale of thousands. Biologists can leverage these libraries to discover small molecules that perform the desired task according to their particular needs. This works showcases several use cases pertinent to microbiology, particularly when live-cell anaerobic environments are required.

Methods: This work utilized the fluorescence activated and absorption-shifting (FAST) tag system, in which a small protein (FAST) targets its cognate small molecule partner (the fluorogen) to produce a fluorescent signal. Both the didermic *Escherichia coli* and monodermic *Streptococcusmutants* were used as model systems to examine fluorescence under various conditions. Fluorogens were either purchased commercially or synthesized via various organic synthesis schemes. Multimodal plate readers and a wide-field epifluorescence microscope equipped with an environmental chamber were used to collect fluorescence data. Quantification was either done on the direct output or after a post-processing step involving a supervised deep learning model trained on part of the data.

Results: Altogether, this work yielded a pilot examination of over 4600 distinct fluorogen chemistries. We found a wide array of alterations in signal intensity, changes in emission and excitation profiles, and sensitivity to the solution acidity. One molecule variant was found with selective cellular entry into *S. mutans* compared to *E. coli*. A comparison between the construction of a large PEGylated-fluorogen and propidium iodide (PI) revealed that the PEG-fluor molecule was more stringent in cellular entry than the smaller PI. This has important implications in commonly performed live-dead cell analyses in terms of false positive interpretations of “dead” cells. Lastly, ongoing work suggests that one fluorogen variant is more readily bound to a “far-red” version of the FAST protein family, with minimal signal emanating from the base FAST protein.

Conclusions: Our goal is to democratize a small molecule screening approach to allow biologists to build novel tools and discover phenotypes related to cell permeability and protein function. We have shown several use cases to that end related to bacterial physiology. We are in the process of performing more library screens to confirm initial findings and expand our chances of capturing more novel phenotypes. Our ultimate goal is to build an expansive dataset incorporating both

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quantum chemical features and phenotypic outcomes of each fluorogen such that a researcher can deploy a machine-learning model to design desired fluorogen traits *in situ*.

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Inhibition of the Interferon Signaling pathway mediated by Extracellular Membrane Vesicles from Oral Commensal Streptococcus sanguinis

Emily Helliwell

OHSU SCHOOL OF DENTISTRY

Co- Authors: Emily Helliwell, Tim Nice, Isabella Rauch, Justin Merritt, and Jens Kreth

Introduction: *Streptococcus sanguinis* is prevalent in the oral cavity and interferes with colonization of oral pathogens. Like other cell types, streptococci produce extracellular membrane vesicles, which contain specific molecular cargo and interact with host cells. Our goal is to define the particular immune response that *S. sanguinis* MVs have on eukaryotic cells, and find how this may differ from an immune response triggered by a pathobiont.

Methodology: We used differential centrifugation methods coupled with image analysis to isolate and quantify *S. sanguinis* vesicles. Proteomic characterization of the vesicle cargo was done via mass spectrometry. To test the immunostimulatory effects, *S.sanguinis* vesicles were inoculated onto gingival epithelial cells, followed by RNA sequencing, gene expression and western blot analysis.

Results: Proteomic characterization of the vesicle cargo identified a variety of proteins, including those predicted to influence host immune responses, including a putative subtilisin-like protease, PrtS. Microscopy studies show that gingival epithelial cells internalize S. sanguinis MVs, resulting in increased production of cytokines IL-8, TNF-α, Gro-α, and IL-6 without causing cell disassociation or death. Transcriptomic analysis of GECs inoculated by *S. sanguinis* EMVs show opposing results; on one hand there is increased expression of cytokines including IL-6 and IL-8; however there is downregulation of several genes involved in the interferon signaling pathway. Further inoculation studies showed that SK36 EMVs inhibited both production of Stat1 and its active form, pStat1, essential components of JAK/STAT signaling in a dose-dependent manner. This effect was not seen in EMVs from an *S. sanguinis* deletion mutant ΔPrtS, suggesting that inhibition of the IFN pathway occurs through the mechanisms of PrtS. SK36 WT EMVs were shown to cleave IFNɣ, while ΔPrtS EMVs had no effect in IFNɣ, suggesting that S. sanguinis EMVs inhibit the IFN signaling pathway through cleavage of one or more interferons.

Conclusion: Our overall findings suggest that *S. sanguinis* MVs trigger an immune response on gingival epithelial cells, however this response is selective and suggests inhibition of some immune signaling pathways. Our results highlight an important role in commensalism; in which a microbe induces an immune response but avoids damage to host cells, thus discouraging infection by pathobionts.

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Session #1

Repurposed antimetastatic drug for dental enzyme inhibition

Jade Wong
Co-Authors: Fernanda Lucena, Matt Logan, Steven Lewis, Carmem Pfeifer

Introduction. This study aims to prevent collagen degradation with the inhibition of matrix metalloproteinases (MMP) to enhance restoration longevity. Repurposing the antimetastatic MMP inhibitor N-Isobutyl-N-(4-methoxyphenylsulfonyl)glycyl hydroxamic acid (NNGH) for use in dental adhesives represents a strategy to preserve dentin bond integrity and improve long-term adhesive performance.

Methods: MMP-2 and MMP-9 activity was quantified fluorometrically over time using a DQ™-gelatin substrate in the presence of NNGH (0.0001-10 µM; (n=3). Hydroxamic acid derivatives were evaluated to confirm inhibitory activity of hydrolyzed NNGH. Gel zymography was performed on recombinant MMP-2 and dentin protein extracts (n=3). Gels were incubated with NNGH or activity buffer at 37 °C for 24 h, stained with Coomassie blue, and densitometry was quantified using ImageJ to calculate percent inhibition. Microtensile bond strength (mTBS) was evaluated using 5th generation adhesives were made with 60wt% bisphenol-A-glycidyl methacrylate (BisGMA), 40wt% 2-hydroxyethyl methacrylate (HEMA), 0.2 wt% camphorquinone (CQ), 0.8% wthyl-4-(dimethylamino)benzoate (EDMAB), 0.4wt% diphenyliodonium hexafluorophosphate (DPI-PF6), 0.1wt% of butylhydroxytoluene (BHT), and a solvent system with 70/30% vol of ethanol/water ratio. No pretreatment and application of DMSO before adhesives were used as controls. Data were analyzed with Welch's T-test, one-way ANOVA, or Kruskal-Wallis/Tukey's test ($\alpha=0.05$).

Results: MMP-2 and MMP-9 were inhibited by hydrolyzed NNGH derivatives on the nanomolar scale for DQ gelatin substrate. The gel zymography dentin protein extracts treated with 25 µM NNGH demonstrated an average MMP-2 inhibition of 97.8% ± 2.1% (n=3). The 12.5 µM NNGH treatment showed 94.5% ± 2.5% MMP-2 inhibition (n=3). In addition, the 6.25 µM NNGH treatment showed 89.2% ± 2.4% MMP-2 inhibition (n=3). The gel zymography recombinant MMP-2 treated with 6.25 - 25 µM NNGH showed MMP-2 inhibition ranging from 49.2% ± 15.0% to 80.0% ± 9.8%. For both the recombinant MMP-2 and dentin protein extract the gel zymography showed a significant increase in %MMP-2 inhibition with the 25 µM NNGH compared to the 6.25 µM NNGH treatment (Dentin protein extract p=0.0116, MMP-2 recombinant p=0.0171). The MTBS was not affected by the addition of NNGH (water: p=0.052; biofilm: p=0.175). However, the control groups showed statistically significant reduction in MTBS between water and biofilm storage, whereas the NNGH groups were able to sustain MTBS values after being challenged in biofilm.

Conclusion: NNGH shows strong potential to preserve dentin-resin bond integrity when applied either as a dentin pretreatment or incorporated into adhesive formulations, primarily by inhibiting MMP-mediated collagen degradation at the hybrid layer.

Translational potential: NNGH can be readily integrated into current adhesive dentistry workflows as either a therapeutic primer or an adhesive-incorporated inhibitor to mitigate enzymatic degradation of the hybrid layer. This strategy targets a fundamental biological pathway underlying bond failure, offering a practical route to extend restoration longevity without increasing clinical complexity.

Funding: NIH-NIDCR R35-DE029083; Silver Family Foundation (Faculty Excellence Award)

Role of the Butyrolactone–Ladderane-Like Hybrid Biosynthetic Gene Cluster (BL-BGC) in Streptococcus mutans Virulence

Rong Mu

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Co- Authors: Rong Mu; Stephanie S. Momeni

Introduction: Streptococcus mutans is a principal agent of dental caries, relying on specialized metabolites to compete within the oral biofilm. A novel hybrid butyrolactone–ladderane biosynthetic gene cluster (BL-BGC) has been identified and is significantly associated with Early Childhood Caries (ECC). We hypothesized that the BL-BGC functions as a regulatory hub coordinating biofilm development and stress homeostasis.

Methods: A whole-cluster deletion mutant (ΔBL-BGC) was generated in the clinical isolate UAB-10 to investigate the functional role of the BL-BGC. RNA-seq analysis was performed on wild-type and ΔBL-BGC strains, with RNA isolated from biofilm cells, to evaluate global transcriptional changes. Biofilm biomass was quantified using crystal violet assays. To validate the phenotype, a stepwise chromosomal complementation strategy was designed, dividing the BL-BGC into three scaffolds for sequential reintroduction into the mutant background.

Results: Deletion of BL-BGC significantly altered gene expression. In the mutant, key biofilm genes (gtfB, gtfC, SpaP, brpA) were downregulated, while gtfD was upregulated, indicating a shift toward more soluble biofilm formation, consistent with crystal violet staining results. Genes involved in cell wall remodeling and secondary metabolite production were disrupted, with stress-response regulators (VicK/R, FtsX) upregulated, suggesting compensatory responses. Type VII secretion and CRISPR-associated genes were also downregulated, indicating impaired secretion and reduced immunity. To confirm these findings, a genome-based sequential complementation strategy is underway to restore the BL-BGC and determine whether reintroduction rescues the wild-type phenotypes, establishing a direct link between the cluster and virulence.

Conclusion: Deletion of the BL-BGC leads to widespread transcriptional changes affecting biofilm formation, stress response, secretion systems, and immune defense pathways in S. mutans. These findings suggest that the BL-BGC influences multiple virulence-associated processes beyond metabolite production. Ongoing complementation studies will determine whether restoration of the cluster rescues the wild-type phenotypes and confirms its contribution to virulence.

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Glymphatics on a chip

Srisankalp Gaddam

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4. Graduate Student, Biomedical Engineering Graduate Program, School of Medicine

Introduction

The glymphatic system, composed of lymphatic vessels and perivascular pathways, serves as the brain's primary fluid transport network, clearing metabolic waste such as amyloid-β. Impairment of this system has been linked to the progression of neurodegenerative diseases, including neuroinflammation and Alzheimer's disease. We hypothesize that neuroinflammation decreases lymphatic drainage before the onset of amyloid- β plaques observed in Alzheimer's-like conditions. Although this relationship has been demonstrated in animal models, the complexity, cost, and duration of in vivo experiments limit mechanistic discovery. Microfluidic platforms offer a controllable and physiologically relevant alternative. Therefore, our goal is to bioengineer a glymphatic system on-a-chip and test the causality of inflammation and decreased lymphatic drainage.

Methods

Devices were designed in Autodesk Fusion with a central chamber perfused by two parallel channels (250 µm wide, 1 mm apart), representing a lymphatic vessel, brain extracellular matrix and an adjacent acellular channel for perfusion. Resin molds were printed using a ProFluidics 285 microfluidics printer, followed by polydimethylsiloxane (PDMS) casting, curing, plasma bonding to glass coverslips, and sterilization. The central chamber was treated with 1% glutaraldehyde to enhance collagen attachment. Acupuncture needles were inserted, and type I rat-tail collagen (2.5 mg/mL) was polymerized overnight. Needle removal created hollow channels that were perfused with media. Experimental devices were seeded with human lymphatic endothelial cells (5×10^6 cells/mL), while control devices contained two acellular channels. To assess drainage function, fluorescent 70 kDa dextran was introduced into the acellular channel to mimic solute transport in perivascular spaces. Dextran distribution was evaluated by fluorescence microscopy.

Results

Fluorescence imaging revealed clear differences between groups. In control chips lacking lymphatic vasculature, dextran freely diffused throughout the collagen matrix, indicating no containment. In contrast, chips containing the bioengineered lymphatic vessel showed dextran confinement within the channel and reduced dispersion into the surrounding matrix. These

findings demonstrate that engineered vessels form a continuous structure capable of limiting solute spread and supporting drainage-like behavior.

Conclusion

This pilot study demonstrates that a functional lymphatic vessel with drainage capacity can be recreated within a microfluidic platform. The engineered vessels form contiguous structures consistent with lymphatic drainage behavior in the brain.

Next steps

Future work will incorporate key brain extracellular matrix components, including fibronectin and hyaluronic acid, to improve physiological relevance. Astrocytes will also be embedded within the hydrogel to investigate their role in waste clearance and to model neuroinflammation and Alzheimer's-related dysfunction in the glymphatic system.

Speed-Dating Pedagogy in Dental Education

Christina Truong
OHSU SCHOOL OF DENTISTRY

Co- Authors: Christina Truong, Rita Patterson, Jeff Jones

Purpose: The aims of the study were to investigate the effects of a speed-dating style, clinical simulation on dental students' anxiety toward patient care, and their confidence in treatment planning.

Methods: Sixty-five dental students participated in a structured intervention involving short, timed rotations through simulated patient scenarios. Pre- and post-intervention surveys measured anxiety and treatment planning confidence on Likert scales. Open-ended questions explored perceived sources of anxiety, challenges in treatment planning, and the overall experience during the simulated exercise.

Results: The intervention was associated with a statistically significant reduction in self-reported anxiety (M = 2.66 to 3.38, $p < .001$, $d = -0.67$) and a statistically significant increase in confidence for discussing both treatment planning (M = 2.27 to 1.96, $p < .001$, $d = 0.45$) and caries (M = 2.07 to 1.88, $p = .027$, $d = 0.29$). Qualitative analysis revealed that students' primary pre-intervention anxieties centered on actual patient care, confidence and communication, and lack of knowledge. Post-intervention, students identified treatment planning challenges related to determining the correct diagnosis, treatment recommendations, and treatment sequencing.

Conclusion: The results of this mixed-method study demonstrated that a speed-dating style simulation exercise can reduce dental students' anxiety and improve confidence in transitioning from preclinical setting to patient care. These findings reinforced that short, structured, and interactive encounters can help students develop critical communication and decision-making skills necessary for clinical practice.

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Session #1

Protein Aggregation in the Eye Lens Due to the Synergistic Effects of Deamidation and Oxidation

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Co- Authors:
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Purpose: Crystallins accumulate numerous post-translational modifications during aging and are resistant to denaturation. Deamidation and oxidation of proteins are two of the most prevalent age-related modifications found in vivo.

Methods: Using high-resolution mass spectrometry, we identified a stepwise mechanism of disulfide crosslinking in γS-crystallin and the effect of deamidation on this pathway. Fully reduced wild type (WT) γS-crystallin and 6 mutants where cysteines were removed from the γS N-terminal domain (C22S, C24S,C22S/C26S, C26S, C36V, and C82A) were incubated in the presence of 2 mM oxidized glutathione (GSSG) for a total of 18 hours and the proportion of the fully reduced protein and oxidized species containing glutathionylation and disulfide bonding were analyzed at various time points by whole mass measurement of the proteins.

Results: Species containing only a single glutathionylation or single disulfide bond appeared early during the incubation but then diminished as they were converted to the more oxidized form. The oxidation behavior of the C24S mutant was dramatically altered. Essentially no glutathionylated species were observed, and only a form containing a single disulfide bond accumulated. The major species upon oxidation with oxidized glutathione is a disulfide bond between Cys 22 and Cys 26 with glutathionylation at Cys 24. The greater heat precipitation observed in the oxidized C22S and C26S mutants may result from these disulfides being more readily moved to C82, with subsequent transfer to C129, forming a C82-C129 crosslink that may lock γS in a non-native conformation that causes precipitation. This potential role of C82 in the translocation of disulfides to the C-terminal domain and subsequent precipitation is supported by the resistance of the oxidized C82C mutant to heat-induced precipitation.

Conclusions: Our previous study examined WT γS and γS C22S, C24S, and C26S mutants following incubation with 2 mM GSSG and localized sites of glutathionylation and disulfide bond formation in tryptic peptide 20-35 containing C22, C24, and C26 using both precursor and fragment ion spectra. In combination with the present study, we have provided a mechanistic view of how GSSG-induced oxidation proceeds in γS. This oxidation pathway provides a plausible mechanism for how oxidation of aged proteins leads to aggregation and cataracts in the human lens.

Poster #95 **Category** FACULTY
Session #1

Effect of ferrule morphology and post-space length on intraoral scan precision

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Co- Authors:
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Introduction: Recent advances in CAD/CAM dentistry and intraoral scanners (IOS) have simplified prosthesis fabrication; however, scanning post-and-core preparations remains challenging due to their deep, narrow design and interference from adjacent teeth. While indirect scanning has been used, direct intraoral scanning is increasingly preferred for efficiency; however, its precision—assessed as the reproducibility of repeated scans—may decrease with longer post spaces or the absence of a ferrule. Factors affecting the precision of optical impressions in post-and-core preparations remain unclear. This study aims to investigate how the presence of a ferrule and the length of the post space influence the precision of IOS scans.

Methods: Artificial maxillary central incisors were prepared as abutment teeth on a typodont (Frasaco ANA-4V) for full-coverage all-ceramic crowns with a circumferential deep chamfer margin at the gingival level. After removing 2.0 mm of coronal tooth structure above the margin, the abutment tooth was scanned using an intraoral scanner (Primescan) and digitized. Based on these digital models, ferrules were created in three configurations using mesh-editing software (Meshmixer): a 2 mm-high circumferential ferrule (Full), a 2 mm-high palatal half-ferrule (Half), and no ferrule (None). Next, post spaces (diameter 2.0 mm, lengths 6, 12 mm in, taper 6°, hemispherical tip) were designed and integrated into the prepared abutments using CAD software (FreeCAD). From these designs, six types of abutment teeth were 3D printed (SprintRay Pro 95S). Printed teeth were mounted on the typodont, placed in a dental mannequin, and scanned five times with the intraoral scanner from canine to canine. Subsequently, STL files were trimmed to the abutment and adjacent teeth using Meshmixer and imported into 3D analysis software (CloudCompare) for alignment and deviation analysis. For three-unit alignment, scans were registered using reference points on adjacent teeth, followed by ICP registration. A single abutment analysis was performed by segmenting the crowns and post spaces. Scanning deviation was quantified as root mean square (RMS) values (μm), calculated from point-to-point distances between repeated scans. Color mapping was applied to visualize deviations.

Results: Scan deviation increased with post space depth in the three-unit superimposition analysis, including adjacent teeth. Values were approximately 100 μm at 6 mm and 100–200 μm at 12 mm, suggesting that larger scanning ranges increase cumulative errors. When analysis was limited to the abutment crown and post space, reproducibility improved markedly, with values ≤15 μm under all conditions.
Color mapping supported these findings. In the three-unit analysis (±200 μm), deviations were mainly observed in peripheral adjacent areas, while the central abutment remained largely green, indicating stitching errors rather than abutment distortion. In the abutment-only analysis (±50 μm), nearly the entire region appeared green at 6 mm, and most wall surfaces remained green even at 12 mm, with minor deviations at the tip.

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Conclusions: The findings of the present study suggest that digital intraoral scanning can achieve high accuracy in reproducing coronal portions of abutment teeth and post spaces. RMS increases observed in wide-area evaluations appear to result primarily from cumulative stitching errors rather than abutment distortion. Limiting the analysis to the abutment and post space may yield very high precision, even for 12-mm-deep post spaces. Precision at clinically relevant wall and marginal regions appears to remain high, supporting the potential feasibility of digital impressions for deep post preparations. Residual crown morphology, particularly in circumferential ferrules at greater depths, may influence scan accuracy and warrants further investigation.

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Category FACULTY

Establishing a ^{13}C-labeled bacterial oral metabolite library for *Streptococcus mutans*

Stephanie Momeni[1],
Co-Authors: Landon Wilson[2], Chris Beecher[3], Stephen Barnes[2]
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Streptococcus *mutans* is an important bacterium responsible for the formation of dental caries. Sucrose is its carbon source, and it utilizes glycolysis for production of energy. The goal of this study was to generate a library of ^{13}C-labeled oral bacterial metabolites to accurately quantify metabolites in different strains of this organism.

Two strains (UAB10 and UA159) were incubated with 95% ^{13}C- and 5% ^{12}C-yeastole/glucose for 6 and 24 hours. Cells were harvested and extracted with ice-cold 80% aqueous methanol. The extracts were subjected to Bligh-Dyer solvent-partitioning and the upper, water-rich phase taken to dryness. Aliquots of this were resolved by reverse-phase LC using a 0-6 min linear gradient of acetonitrile (0-100%) in 0.1% formic acid. Using electrospray ionization, high-resolution TOF mass spectra (*m/z* 50-1000) were recorded at 4 Hz throughout the analysis.

Analysis using MZmine 3 revealed few differences in ion intensities in TICs of extracts at 6 and 24 hours, establishing ^{13}C-labeling reached equilibrium quickly. In addition, the TICs of UAB10 and UA159 strains were similar, suggesting that most high abundance metabolites were in common across the strains. Examination of individual metabolites revealed that common amino acids (e.g., phenylalanine) were ^{13}C-labeled, but tricarboxylic acid cycle intermediates (e.g., citrate, isocitrate) were unlabeled, consistent with glycolysis as the source of energy. A combined UAB10/UA159 sample was used as a standard, then used in a constant amount in varying combinations with unlabeled extract of UAB10/UA159 cells to determine ion suppression normalization. A total of 415 known and 603 unknown metabolites were ^{13}C-labeled.

This study demonstrates the feasibility and conditions to create a ^{13}C-labeled *S. mutans* metabolite reference library. Creation of this library will allow for standardization of dental caries bacterial metabolomics studies and establish an unprecedented model for optimization of other oral bacteria to create an oral bacterial metabolite reference library (OBMRL).

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CATEGORY FACULTY

2026 Research Day

Thursday, March 5
Robertson Life Science Building, Portland, OR

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4	Bola Gyras	Bola Gyras	Impact of CAD/CAM Denture fabrication on post-insertion adjustment visits in Edentulous patients
18	Carly Haimerl	Grace Oh	Advantage of VR-Haptics Over Traditional Training Methods in Preclinical Dental Curriculum
28	Cole Buller	Cole Buller, Jason Zhao, Maria Ayad, Joshua Allen, Colin Wong	How much Xylitol is necessary to reduce the risk of caries?
24	Daniel Chen	Daniel Chen	Class II Correction with Orthodontic Appliances: Dental or Skeletal
20	Daniel Kim		
30	Everett Tran	Everett Tran, Justin Kim, Nikolaos Soldatos	The Use of Tunnel vs Coronally Advanced Flap Technique in Soft Tissue Grafts
6	Finn Peck	Finn Peck, Harjit Sehgal	Putting the Shield to the Test: Evaluating Bone Preservation of the Socket-Shield
26	Graham Kang	Graham Kang	The Effect of MARPE on Obstructive Sleep Apnea in Adults with Maxillary Transverse Deficiency
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8	Hunter Rothfus	Hunter Rothfus	Evaluating the current evidence of hydrogel scaffolds in regenerative endodontic therapy of necrotic immature teeth
10	Jamie Colson	Jamie Colson, Gabrielle Hanna-Choquette, Adrianne Orahood	Fluoride Hesitancy with Topical Fluoride Varnish in Caregivers of Pediatric Patients
22	Joelle Lanoue	Joelle Lanoue, Allison Lee, Aidan Huynh, Min Kyung Kim, Noah Kroll	Smoking Cessation: Balancing Oral Health Benefits and Risks
34	Jonathan Cha	An Vu, Leland Wong, Colin Wong, Jonathan Cha, Howard Freedman	Impact of Orthodontic Extractions on Radiographically Measured Pharyngeal Space
12	Kai Kiyokawa	Kai Kiyokawa	Treatment Timing and Skeletal Outcomes of Rapid Maxillary Expansion
38	Kevin Vu	Kevin Vu, Beryl Chen	Regenerative Dentistry: The Emerging Clinical Role of Dental Pulp Stem Cells
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44	Arissa Garcia	Arissa Garcia	Impact of Participation in Post-Exam Review on Non-Cumulative Didactic Exam Scores During Year 1 of the OHSU DMD Program
50	Ellie Anderson	Ellie Anderson, Madeleine Daly, Dustin Higashi, Dr. Justin Merritt	Investigating the Role of Parvimonas micra Host-Modifying Effector Proteins
36	Jonathan Cha	J. Cha, L. R. Iwasaki, H. Liu, D. Choi J. C. Nickel	Nocturnal Autonomic Nervous System Power Density and Mandibular Growth in Children
40	Khalil Tams	Khalil Tams, Pinaaz Hode, Pragyan Paramita, Avery Billo, Christopher Tams, Felipe Sperandio, Cristiane Miranda Franca	Spatial Transcriptomics Pipeline to Understand Key Drivers of Oral Squamous Cell Carcinoma Progression
54	Nicole O'Dierno	Chloe Zhou, Nicole O'Dierno, Ginny, Hsu, Siyu Chen, Jacqueline Thrower, Graham Kang, Daniel Chen	Unmet Needs in Orthodontic Care: AI-Augmented Insights from Clinician Interviews
42	Peter Nguyen	Fernanda de Lucena, Tiana Pham, Samuel Weber, Matthew Logan, Steven Lewis, Carmem Pfeifer	Use of Quaternary Ammonium Adhesives To Improve Resin Composite Marginal Integrity
32	Sabrina Cesare	Sabrina Cesare; Jakob Wilson; Dr. Vesna-Lea Ferrer	CBCT usage, imaging protocols, and interpretation for orthodontics
46	Tiana Pham	Jade Wong, Carmem S. Pfeifer, Fernanda Sandes De Lucena	Development of Podocarpic Acid–Loaded Dental Composites for Antimicrobial Applications
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56	Edward Tran	Edward Tran and Ben Lively	The Influence of Restoration Timeliness and Type on Posterior Tooth Survival After Non-Surgical Root Canal Treatment: A Retrospective Survival Analysis
58	Faisal Shakir	Pinaaz Hode, Alakananda M. Sreeramadas, Molly Mccoy, Adam Lloyd, Cristiane M. Franca.	High-Concentration TAP Detoxifies Deep Dentinal LPS
60	Sara Henry	Sara Henry, Andrew Lane, Elizabeth Palmer, Hongseok An	Pediatric Prosthodontic Education Across Residency Programs
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64	Hua Zhang	Hua Zhang, Hui Wu	AI-Driven Design and Validation of Novel Binders Targeting Biofilm-regulatory protein (BrpA)
66	Larissa Pavanello Pandolfo	Larissa Pavanello Pandolfo, Tapas Ghosh, Sivashankari Rajasekaran, Karina Cogo Müller, Ana Paula Fugolin	Development of Chlorhexidine-Loaded Nanomicelles for Dental Applications
68	Yong Sun	Yong Sun, Chang Hyun Byon, Xinyang Zhao, Hui Wu and Yabing Chen	O-GlcNAcylation of Runx2 is critical for its interactome and vascular calcification
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72	Fernanda Sandes De Lucena	Fernanda Sandes de Lucena, Jade Zago, Jade Wong, Steven Lewis, Matthew Logan, Carmem Pfeifer	Repurposing Approved Drugs to Target Cell Wall Integrity in Enterococcus faecalis
74	Guilherme Rocha	Guilherme Roncari Rocha, Wesley Gomersall, Noora Azadvari, Parisa Hosseinzadeh, Carmem Pfeifer	Designing precision peptides to manage Streptococcus mutans population.
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88	Dustin Higashi	Dustin L. Higashi, Hua Qin, David Anderson, Christina Borland, Elizabeth A. Palmer, Jens Kreth, and Justin Merritt	Parvimonas manipulation of the host innate immune response through the manipulation of a master regulator of hypoxia contributes to the promotion of a pro-inflammatory feedback cycle.
90	Hua Qin	Hua Qin, Dustin Higashi, Madeline Krieger and Justin Merritt	Development of a versatile toolbox for genetic manipulation of Prevotella melaninogenica
92	Matthew Barbisan	Matthew Barbisan (Daniel Kim, Sadie Gavriela Drucker, Michelle Lee, Jonathon L. Baker)	Epigenomics identifies multiple types and sources of DNA methylation in Streptococcus mutans UA159
82	Pinaaz Hode	Pinaaz Kiran Hode, Alakananda Melethil Sreeramadas, Pragyan Paramita, Mauricio Sousa, Cristiane Miranda Franca	Effect of hyperglycemia and collagen properties on monocyte differentiation into macrophages
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Investigating Parvimonas micra Cell Wall Biogenesis Through Cloning-Independent Mutagenesis

Anh Nguyen

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Parvimonas micra is a Gram-positive, and anaerobic bacterium linked to oral infections such as periodontitis and endodontic disease. P. micra possesses a thick peptidoglycan cell wall critical for structural support and osmotic protection. Despite its clinical significance, the mechanisms underlying cell wall biogenesis in P. micra remain largely unexplored. The goal of this project is to investigate the functional roles of three candidate enzymes predicted to be involved in peptidoglycan hydrolysis in P. micra. To achieve this, we sequenced complete genome of P. micra and selected 3 different peptidoglycan genes. Then, we generated individual gene knockouts with erythromycin resistance gene (erm) as the selectable marker. DNA construct was introduced via natural transformation. Mutants were screened, and phenotypes were evaluated. Autolytic enzymes were subsequently isolated, purified, and applied to wild-type P. micra cultures to assess lytic efficiency. The functional activity of two autolysin, WJ11_05300 and WJ11_02225, was validated through observable changes in cell morphology and successful chromosomal DNA isolation, confirming their lytic capabilities. Our findings indicate that while these genes are not essential for cell viability, their disruption alters cell wall integrity and structure, supporting their functional relevance in peptidoglycan remodeling. This study provides new insight into the complexity and regulatory mechanisms of bacterial cell wall integrity. Our work lays the foundation for the development of more precise and targeted antimicrobial strategies aimed at weakening bacterial defenses.

Poster #48
Session #2

Category DMD/ Research

Impact of Participation in Post-Exam Review on Non-Cumulative Didactic Exam Scores During Year 1 of the OHSU DMD Program

Arissa Garcia
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Abstract not available

Poster #44
Session #2

Category - DMD Student

Investigating the Role of Parvimonas micra Host-Modifying Effector Proteins

Ellie Anderson

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Co- Authors:
Ellie Anderson, Madeleine Daly (OHSU School of Dentistry Summer Research intern, University of Arizona), Dustin Higashi, Dr. Justin Merritt

Parvimonas micra (Pm) is an inflammatory pathobiont strongly associated with oral diseases, such as periodontitis, infected root canals, and odontogenic abscesses, as well as certain cancers. A critical theme uniting these diseases is the interplay between inflammatory immune responses and the overgrowth of inflammophilic (inflammation-loving) bacteria such as Pm. Preliminary data from our laboratory suggests that Pm may be a significant driver of this inflammation. To investigate this further, we employed a search algorithm to identify potential Pm candidate effector proteins that are hypothesized to manipulate host cellular processes. To study these candidate effectors and their role in infection, we: 1) Constructed Pm strains constitutively expressing hemagglutinin (HA)-tagged candidate effector proteins, allowing us to confirm protein expression and cellular localization. 2) Generated Pm deletion mutant strains in the candidate effectors. These mutant strains provide critical tools in the further study of Pm-host interactions and their role in inflammation and disease.

Poster #50
Session #2

Category DMD/ Research

Nocturnal Autonomic Nervous System Power Density and Mandibular Growth in Children

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Co- Authors: J. Cha, L. R. Iwasaki, H. Liu, D. Choi J. C. Nickel

Objectives: This study tested the hypothesis that increased ratios of sympathetic/ parasympathetic nervous system activities correlated with increased mandibular growth.

Methods: In accordance with OHSU Institutional Review Board oversight, skeletal Class II children aged 10-14 years who required Herbst appliance therapy (HAT), provided informed consent, and were trained in research protocols for recording Heart Rate Variability (HRV) data at home. Subjects were asked to produce 4 night-time recordings of ≥6 hours in duration using portable recorders. Cone-Beam Computed Tomographic images (CBCT) recorded at baseline and 12 months after HAT were used to measure growth related changes in mandibular (Co-Gn, mm) and ramus (Co-Go) lengths. Nocturnal ultradian cycling of parasympathetic and sympathetic activities was quantified using commercial software (MindWare Technologies LTD.). Autonomic activity was analyzed through Heart Rate Variability (HRV) metrics, yielding sympathetic power (LF, %) and parasympathetic power (pNN50, ms). A custom program (MatLab, Mathworks Inc.) fitted a high order polynomial to HRV data. Based on the polynomial, two peaks and two troughs of ultradian cycles were identified for each recording to quantify amplitudes and durations of pNN50 and LF activities. Power densities for each were calculated by dividing amplitude by time. Linear Regression analyses tested for correlation between the ratio of sympathetic and parasympathetic power densities and mandibular growth.

Results: Thirty children (14 female, 16 male) participated in the study. Each subject produced an average of 3.4 recordings, of average duration of 8.8 hours. Sympathetic/parasympathetic power density was linearly correlated with growth changes in mandibular (R2 = 0.63) and ramus (R2= 0.63) lengths.

Conclusion: Increased nocturnal sympathetic-to-parasympathetic power density ratios were correlated with mandibular and ramus growth in children undergoing Herbst appliance therapy.

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Session #2

Spatial Transcriptomics Pipeline to Understand Key Drivers of Oral Squamous Cell Carcinoma Progression

Khalil Tams

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Introduction: Most human cancers arise in epithelial tissues, where disruption of immune-epithelial interactions contributes to the transition from premalignant dysplasia to carcinoma. Although many premalignant lesions never progress, current clinical management relies largely on serial biopsies, hematoxylin and eosin (H&E) grading, and prolonged surveillance, approaches with limited predictive power. There is a critical need to better define the mechanisms driving premalignant progression and to develop more accurate tools for risk stratification. Building on evidence that tumor behavior is shaped not only by immune cell composition but also by their spatial organization, we hypothesize that immune cells form spatially defined "hubs" that may either suppress or promote tumor progression, and that spatial transcriptomics can enable their identification and characterization.

Methods: We will analyze paired biopsies from eight patients with premalignant lesions that subsequently progressed to carcinoma (n = 16 samples), which were previously processed using Visium HD spatial transcriptomics. A machine learning-based computational pipeline will be developed to establish a scalable framework that links histopathologic features with the spatial architecture of immune hubs. Spatial analysis methods will classify immune hubs as inflammatory or immunosuppressive and generate predictive progression risk scores. In parallel, unsupervised clustering will identify recurrent immune hub subtypes, and ligand-receptor network inference will define signaling pathways associated with malignant transformation.

Results: Preliminary data include samples from three patients with normal, premalignant, and malignant oral lesions. Histological sections were processed for Visium HD, and a spatial transcriptomics pipeline is being established to generate high-resolution gene expression maps across disease stages. The regions currently identified are larger than the expected size of immune hubs, which are anticipated to comprise fewer than 100 cells.

Conclusions: These findings represent initial steps toward establishing a spatial transcriptomics pipeline to identify immune hubs in premalignant lesions. Future work will integrate cyclic immunofluorescence and refine the analysis to detect and evaluate smaller, spatially restricted regions.

Poster #40 **Category** DMD/ Research
Session #2

Unmet Needs in Orthodontic Care: AI-Augmented Insights from Clinician Interviews

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Introduction
Innovations in orthodontics have been led by 3D printed appliances, clear aligners and digital scanning that even eliminated the need for analog impressions. Most of these innovations have included new products that save time and hassle in the operatory, but few have tried to streamline clinical diagnostics nor addressed shortcomings of current treatment planning. This study investigated the gap between current clinical practices and the unmet needs that remain in orthodontic practice.

Methods
Providers across the field of orthodontics, general dentistry, and pediatric dentistry were screened. Twenty-three providers who practice in private clinic settings were selected to take part in the descriptive qualitative study after applying the screening criteria. The criteria excluded providers who no longer practice actively and those who do not provide orthodontic treatments to adults or pediatric patients. Human researchers conducted the interviews using a virtual conference platform and each lasted 15-30 minutes. The questions asked during the interview addressed unmet medical needs, treatment complications, and technologies known to address various complications. The responses were transcribed verbatim. An analysis was run for each question compiling the responses from all the providers. Using the inductive-deductive hybrid framework, the study employed an AI-agent supported by ChatGPT-5 for thematic analysis and provide a summary of findings while the human researchers refined the coded passages for accuracy.

Results
The practitioners mentioned orthodontic concerns including lack of adherence or stability, root resorption, and gingival recession and bone loss. Other concerns were predicting growth patterns in pediatric patients, and overall communication with parents to ensure good oral hygiene and compliance during treatment. There were also anatomical structures that the clinicians wanted to

be able to visualize better. Some examples include alveolar bone morphology, eruption paths, ankylosis, and soft tissue abnormalities. Currently CBCT can help visualize hard tissues, but the soft tissues are largely left to clinical examination and judgement.

Conclusion

This qualitative study demonstrates that the principal unmet needs in contemporary orthodontics relate less to treatment mechanics and more to the inherent unpredictability of biological systems and patient behaviors. Clinicians identified relapse, root resorption, gingival recession, and growth-related variability as dominant challenges, driven by limited ability to visualize and predict anatomical change over time. Existing technologies remain insufficient to help clinicians confidently plan for treatments for challenged cases including thin gingival biotypes. These findings highlight a critical need for technological innovation that can help reliably forecast the dynamics of anatomical evolution in each patient

Use of Quaternary Ammonium Adhesives to Improve Resin Composite Marginal Integrity

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Objectives.
Methacrylate-based dental adhesives undergo increased degradation when subject to hydrolysis, degradation by endogenous matrix metalloproteinase (MMP), and bacterial challenges. Quaternary ammonium compounds (QACs) are known for its antibacterial properties and have also been shown to have inhibitory potential against MMPs. This study aims to use a bioreactor system to simulate physiologically relevant conditions to evaluate bond stability and gap formation of an experimental quaternary ammonium-based methacrylate adhesive (dimethylaminohexadecyl methacrylate; DMAHDM, QAM).

Materials and Methods.
5th generation experimental adhesives were formulated from the control BisGMA/HEMA (70/30wt%) adhesive and either 2% chlorhexidine (CHX) or 10% QAM. The degree of conversion (DC) of the formulations was evaluated through infrared spectroscopy (near-IR; n=6). Standardized dentin samples were prepared using a milling system, acid etched (35% phosphoric acid for 15 seconds), the experimental adhesives were applied in two layers and photocured with a LED unit (ELIPAR, at 830mW/cm2) for 20 seconds and restored with a commercial resin composite (Filtek Supreme, shade A2). Samples were subject to bacterial and mechanical challenges under static incubation or dynamic conditions using a bioreactor model (n=5). Epoxy replicas made before and after each simulated "year" for measurement of gap measurements using scanning electron microscopy (SEM) and ImageJ software.

Results. The perimeter gap length (PGL) and occlusal gap width (OGW) in both experimental 2% CHX (PGL p = 0.989, OGW p = 0.118) and 10% QAM (PGL p = 0.989, OGW p = 0.118) adhesives did not significantly change after the mechanical challenges (in water). The perimeter gap length (PGL) and occlusal gap width (OGW) in both experimental 2% CHX (PGL p = <0.001, OGW p = <0.001) and 10% QAM (PGL p = <0.039, OGW p = <0.001) adhesives significantly increased after subject to bacterial challenges. No difference was observed between the adhesives before (p= = 0.296) or after (p = 0.148) the bacteria challenges. This suggests that the primary driver of early marginal breakdown is biofilm activity rather than mechanical stress.

Conclusion.
Biological challenges were the dominant driver of marginal degradation compared with mechanical stress. Despite the MMP inhibitory capacity of quaternary ammonium methacrylates, their incorporation into the adhesive did not significantly reduce marginal degradation in the presence of bacterial challenge.

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Session #2

CBCT usage, imaging protocols, and interpretation for orthodontics

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Co- Authors: Sabrina Cesare; Jakob Wilson; Dr. Vesna-Lea Ferrer

Cone-beam computed tomography (CBCT) provides three-dimensional views of craniofacial and dental structures, offering superior diagnostic accuracy and treatment planning over 2D radiography. While highly valuable in dentistry, CBCT presents risks of increased radiation exposure, a significant concern for highly radiosensitive pediatric patients. Currently, no recent consensus protocols specific to orthodontics exist. Updates to clinical guidelines from the American Dental Association (ADA) and American Academy of Oral and Maxillofacial Radiology (AAOMR) are ill-defined in terms of formalized training and standardized utilization.

Using survey methodology, this study aims to (1) assess the clinical indications and decision-making criteria that prompt CBCT imaging among orthodontists; (2) evaluate the presence and nature of formal CBCT imaging protocols in orthodontic practices; and (3) determine who is responsible for CBCT acquisition, interpretation, and integration of findings into patient care. Results of the study will inform the development of guidelines in utilization of CBCT specific to orthodontics and will identify educational gaps for guideline alignment.

An initial literature review informed the investigators in the creation of two sets of questionnaires, each consisting of approximately eight demographic and 21 main body questions. The draft questionnaires were refined by a focus group of four full-time faculty members of OHSU School of Dentistry (SOD) Division of Orthodontics. A pilot group composed of 12 Orthodontics and one Oral Radiology faculty members at OHSU SOD and one outside oral radiologist-orthodontist will finalize the survey questionnaires. These survey questionnaires will be administered to orthodontist-members of the American Cleft Palate Craniofacial Association (ACPA) and members of the American Association of Orthodontics (AAO) to collect empirical data from Craniofacial Orthodontics specialists and orthodontists, respectively. The generated data will provide a foundational baseline for evaluating current clinical protocols and will inform an update on imaging and educational guidelines to optimize patient care and radiation safety.

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Category DMD/ Research

Development of Podocarpic Acid–Loaded Dental Composites for Antimicrobial Applications

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Introduction

Current antimicrobial strategies have limited long-term efficacy, lack specificity, and may induce cytotoxic effects. Podocarpic acid (PA), a phenolic diterpenoid derived from Podocarpus species, found in the resin of coniferous trees, exhibits antibacterial activity against several Gram-positive pathogens. PA conjugation with amides/polyamines permits electrostatic interactions between positively charged PA and negatively charged gram-positive cell membrane, leading to membrane penetration and disruption, without undesired cytotoxic properties. The objective of this project is to establish PA antimicrobial activity against *Streptococcus mutans (S. m.)* with the goal of incorporation of PA into methacrylate-based composites to provide controlled drug release without compromising material properties.

Methods

Isolated colonies of *S.m.* were inoculated into sterile Brain Heart Infusion (BHI) broth and grown overnight. Overnight culture was transferred to fresh BHI supplemented with 1% sucrose and incubated for 4.5 h. 6 serial 2-fold dilutions of PA was done by dissolving in dimethyl sulfoxide at a final concentration not exceeding 0.2% (v/v) to facilitate solubilization before addition to *S.m.* medium (n = 5). Well plates were incubated at 37 °C, 5% CO_2, static for 24 h. Absorbance of supernatant from each well was measured using a microplate reader. Viability was measured using *S.m. renilla* reporter strain.

Results

Initial experimentation with PA concentrations below 100 µM resulted in no inhibition. The experiment was repeated with higher concentrations of PA (0-2.5 mM). Inhibition of both planktonic and biofilm *S.m.* growth was seen at higher PA concentrations. Viability of *S.m. renilla* biofilm was decreased.

Conclusion

While PA was seen to inhibit *S.m.* growth, concentrations that allow for inhibition is too great for incorporation of PA into methacrylate-based composites and will likely compromise material properties. Current results show that PA as an antimicrobial is not translatable to dental materials.

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Session #2

The Influence of Restoration Timeliness and Type on Posterior Tooth Survival After Non-Surgical Root Canal Treatment: A Retrospective Survival Analysis

Edward Tran

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Co- Authors:
Edward Tran and Ben Lively

This study evaluated how temporal factors and definitive restoration type direct (composite/amalgam) or indirect(crown/onlay) affect the long-term survival of endodontically treated posterior teeth. It also identified specific time points at which delays in restoration placement significantly increase failure risk. This retrospective cohort study (n=1,774 posterior teeth) used patient records from a U.S. dental school. The mean patient age was 55.9±15.6 years. The primary outcome was the temporal occurrence of an adverse event—defined as extraction, nonsurgical retreatment, or apical surgery—measured from completion of the initial endodontic treatment. Mclust analysis empirically defined optimal time clusters, and Cox proportional hazards regression tested the predictive significance of the time threshold and restoration type, controlling for patient age and clinic discipline (p=0.05). The overall incidence of an untoward event was 7.0% (n=124). Median time to completion was 34 days for direct restorations and 170 days for indirect restorations. Mclust clustering identified a critical threshold of ≤38 days for timely restoration. Cox regression showed both restoration type and the 38-day threshold were significant predictors of survival ($p<0.001$ for both). The delayed group (> 38 days) demonstrated a significantly higher hazard for untoward events ($p<0.001$) compared with the timely group (≤38days). Direct restorations also exhibited greater risk than indirect restorations ($p<0.001$). Early placement of the definitive restoration is critical for long-term survival of endodontically treated teeth. Delays beyond 38 days significantly increase adverse outcomes. A definitive restoration within 38 days, preferably indirect, provides optimal structural protection and prognosis.

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Session #2

High-Concentration TAP Detoxifies Deep Dentinal LPS

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Introduction
Residual lipopolysaccharide (LPS) can contribute to the unpredictability of regenerative endodontic procedures (REP) in previously infected teeth. It activates immune cells to a pro-inflammatory state incompatible with regeneration. The efficacy of Triple Antibiotic Paste (TAP) has been investigated in microbial disinfection of REP; however, its effect on LPS detoxification is unclear. This study evaluated low- and high-concentration TAP versus $Ca(OH)_2$ and NaOCl/EDTA for reducing dentinal LPS. We hypothesized that TAP clears LPS in a concentration-dependent manner.

Methods
Extracted uniradicular human teeth were prepared to size 4 Gates-Glidden, pretreated with 17% EDTA and 5.25% NaOCl. Fluorescently-tagged LPS was centrifuged into the dentin to create an LPS-dentin model. Teeth were assigned to six groups (5 teeth/group): negative control (no LPS), positive control (LPS, no disinfection), NaOCl/EDTA, $Ca(OH)_2$, 5 mg/mL TAP, and 125 mg/mL TAP. Following treatment, teeth were incubated for 1 week at 37°C. Teeth were sectioned and imaged by fluorescence microscopy. FIJI was used to quantify LPS-positive area and peri-canal fluorescence intensity. Data were analyzed by one-way ANOVA followed by Tukey's post-hoc test (α=0.05).

Results
LPS penetration was normalized considering the positive control as the maximum penetration (100%). Only the TAP 125 group showed LPS penetration significantly lower than the positive control (p=0.04). The intensity of LPS was significantly lower in all groups compared to the positive control (p=0.02). Interestingly, TAP 125 had two samples with almost complete clearance of LPS (p=0.0003).

Conclusions
High-concentration TAP showed the greatest LPS reductions, suggesting benefit for LPS control in REP.

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Session #2

Pediatric Prosthodontic Education Across Residency Programs

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Co- Authors: Sara Henry, Andrew Lane, Elizabeth Palmer, Hongseok An

Introduction:
Craniofacial anomalies are rare in the pediatric population; however, when present, they may cause significant challenges in the provision of appropriate prosthodontic care. Pediatric patients with craniofacial differences are typically first seen by a pediatric dentist, who may attempt to coordinate care with a prosthodontist. Unfortunately, many of these patients remain with unmet treatment needs. One possible reason for this gap in complex care could be that neither pediatric dentists nor prosthodontists are adequately trained to provide these services. Our study investigated the educational experiences in interdisciplinary pediatric prosthodontic treatment currently being provided in pediatric dentistry and prosthodontic residency programs.

Methods:
An invitation to participate in anonymous two-part Qualtrics survey was sent to all US and Canadian pediatric dentistry and prosthodontic residency program directors. The survey obtained information on program location and patient demographics as well as specialty specific questions on common craniofacial anomalies treated, whether pediatric prosthodontic education and clinical exposure is included in the curriculum, and prosthodontic treatment options that are available in their clinic. Data was organized into K by 2 tables to determine similarities and differences between the pediatric prosthodontic education and clinical training available by pediatric dentistry and prosthodontic residency programs.

Results:
Total responses were included 20 pediatric dentistry program directors and 14 prosthodontic program directors. Results revealed a discrepancy between clinical exposure and formal education: 70% of pediatric and 64.3% of prosthodontic programs provide clinical exposure, while only 40% and 28.6%, respectively, offer formal didactic training.
Specialty-specific differences in clinical comfort were noted. Pediatric directors reported that they were 80% and 75% comfortable with providing removable partial dentures and zirconia crowns, respectively, but 30% or less reported comfort providing any other prosthetic treatment. Additionally, 65% or less prosthodontic directors expressed comfort providing any sort of prosthetic treatment to pediatric patients. These findings support the hypothesis that interdisciplinary training in pediatric prosthodontics residency programs is currently lacking. However, there was mixed opinions between directors on whether it is beneficial to incorporate pediatric prosthodontic training into their programs: 60% of pediatric dentistry versus 50% of prosthodontic program directors believe it is beneficial.

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Conclusions:

There is an educational gap in pediatric prosthodontics, marked by moderate clinical exposure but limited didactic training. The perception of barriers to care, particularly patient behavior, suggests that technical skill alone is insufficient without pediatric-specific pediatric training. These findings support the need for an interdisciplinary curriculum and collaboration that could bridge these gaps, ensuring that residents in both specialties are prepared to manage the complex needs of pediatric patients. Further investigation is needed into why the interdisciplinary curriculum in pediatric prosthodontics is lacking, and the changes that could be done to residency programs to increase didactic training and clinical exposure.

Guardian Perceptions of HPV and the Role of Pediatric Dentists in Vaccine Advocacy and Administration

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Co- Authors: Yoseline Vidrio, DDS; Jacy Stauffer, DMD; Yifan Zhang, DDS, PhD, M.Sc

Introduction and Purpose:
Across the United States, Human Papillomavirus (HPV) is a preventable cause of oropharyngeal cancer, yet adolescent vaccination rates remain suboptimal. This is especially relevant in Oregon, where uptake falls below national averages. Frequent dental visits with pediatric dentists that build trust and rapport uniquely positions the dental setting for preventive advocacy. This study evaluated guardian knowledge, trust, and willingness to accept HPV vaccination services at OHSU, identifying socioeconomic and perceptual factors that influence whether families view the dental office as a trusted extension of the medical home.

Methods:
A cross-sectional study was conducted at OHSU pediatric dental clinics, using convenience sampling during scheduled dental visits to recruit guardians of patients aged 7–18. To participate, caregivers had to be at least 18 years old, fluent in English or Spanish, and familiar with their child's vaccination history. Participation was voluntary and involved minimal risk. Surveys were administered in person via a secure QR code linked to Qualtrics and completed onsite. Survey items assessed caregiver demographics, HPV knowledge, trust in pediatric dentists as general health providers, willingness to receive HPV vaccine counseling or administration in dental settings, and perceived barriers and facilitators to dental-based vaccination. Descriptive statistics were used to characterize the sample. In addition, bivariate analyses and binary logistic regression were used to find the strongest predictors of vaccine acceptance, specifically focusing on trust and socioeconomic factors.

Results: The survey was completed by 83 participants. While 77.1% reported trusting pediatric dentists to provide preventive health counseling beyond oral care, only 49.4% were willing to allow HPV vaccine administration in a dental setting. Willingness did not differ by caregiver age, gender, education, race/ethnicity, or HPV knowledge, but was significantly associated with household income. Caregivers earning ≥ $50,000 annually had approximately fivefold higher odds of willingness compared with those earning <$25,000 ($p<0.05$). Trust emerged as the strongest predictor of acceptance and caregivers who trusted their pediatric dentist were 63.2 times more likely to accept dental-based HPV vaccination ($p=0.001$). Preference for primary care providers was the most commonly reported barrier (62.5%), while 82.9% indicated that specialized provider training would increase comfort.

Conclusions:
Pediatric dental clinics represent a high-potential but underutilized setting for HPV vaccine advocacy. Although trust in pediatric dentists is high, a gap persists, particularly with lower-income families. Acceptance appears to be driven by professional trust and perceptions of provider roles rather than HPV knowledge. Targeted outreach to lower-income populations, specialized vaccine

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advocacy training, and collaborative care models with primary care providers may bridge this gap and support expansion of HPV prevention efforts in pediatric dental settings. In Oregon, where HPV vaccination uptake remains below national benchmarks, pediatric dental clinics may serve as an important **link** in expanding cancer prevention efforts.

AI-Driven Design and Validation of Novel Binders Targeting Biofilm-regulatory protein (BrpA)

Hua Zhang

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Co- Authors:
Hua Zhang, Hui Wu

Introduction
Biofilm formation is a critical virulence factor in bacterial pathogenesis, often regulated by key proteins such as BrpA. Targeting these proteins offers a promising therapeutic strategy to disrupt biofilm integrity. In this study, we integrated computational modeling with experimental validation to develop high-affinity inhibitors capable of neutralizing BrpA activity.

Methods
We employed an AI-driven framework and *in silico* screen to design novel protein binders targeting BrpA. To validate these designs, recombinant BrpA (rBrpA) and the designed binders were expressed in *Escherichia coli* and purified using His-tag affinity and size-exclusion chromatography. Molecular interactions and binding affinities (KD) were characterized using biolayer interferometry (BLI). Furthermore, the functional efficacy of the synthesized inhibitors was evaluated through biofilm assays utilizing fluorescent glucan staining to visualize inhibitory effects.

Results
Computational models successfully identified several high-affinity candidates. Experimental characterization via BLI confirmed robust binding between the designed binders and rBrpA. Subsequent biofilm assays demonstrated that these molecules significantly inhibited BrpA function, leading to a measurable reduction in glucan-mediated biofilm formation compared to untreated controls.

Conclusion
Our results demonstrate the power of combining AI-driven design with rigorous *in vitro* validation to accelerate the discovery of biofilm inhibitors. These novel BrpA binders represent a significant step toward the development of targeted anti-biofilm therapies.

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Development of Chlorhexidine-Loaded Nanomicelles for Dental Applications

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BIOMATERIAL AND BIOMEDICAL SCIENCES, OHSU SCHOOL OF DENTISTRY

Co- Authors:
Larissa Pavanello Pandolfo, Tapas Ghosh, Sivashankari Rajasekaran, Karina Cogo Müller, Ana Paula Fugolin

Introduction: Periodontal disease progression and degradation of the resin-dentin adhesive interface are driven by the dysregulated activity of endogenous matrix metalloproteinases (MMPs). While chlorhexidine (CHX) is a potent MMP inhibitor and antimicrobial agent, its clinical efficacy is often compromised by rapid leaching and lack of site-specific delivery. To address these limitations, this study developed MMP-responsive nanomicelles to encapsulate chlorhexidine (CHX-NM) to serve as a smart "on-demand" delivery platform. These nanocarriers are engineered to sequester CHX and trigger its release specifically in response to proteolytic activity, ensuring targeted and sustained therapeutic concentrations at the bio-interface. By synchronizing MMP inhibition with localized antimicrobial action, this platform offers a promising strategy to enhance the longevity of dental restorations and improve the management of periodontal pathologies.

Methods: MMP-2/-9-responsive nanomicelles were prepared by conjugating L-form peptide sequences, recognized and cleaved by the target enzymes, to a block copolymer. Micelle formation was then performed with simultaneous encapsulation of CHX, yielding CHX-loaded nanomicelles (CHX-NM). Bare nanomicelles were synthesized as control. The physicochemical properties and responsivity of the nanomicelles were assessed by Dynamic Light Scattering (DLS) and Transmission Electron Microscopy (TEM) before and after incubation with MMP-2/-9 (n=5). Micelles stability was assessed by zeta potential measurements (n=5). CHX encapsulation efficiency was determined by High-Performance Liquid Chromatography (HPLC) (n=3). The antimicrobial activity of CHX-NM was evaluated using a minimum inhibitory concentration (MIC) assay against *Streptococcus mutans* (IdhRenGSm) and *Porphyromonas gingivalis* (ATCC 33277) (n = 6). Free CHX was used as a control. Statistical analysis was performed using ANOVA followed by Tukey's post hoc test ($\alpha = 0.05$).

Results: CHX-NM exhibited an average hydrodynamic diameter of 130.0 ± 1.7 nm and a low polydispersity index prior to enzymatic treatment, indicating a highly homogeneous population. The nanomicelles presented a negative surface charge, with a zeta potential of -29.2 ± 1.4 mV, and a spherical morphology, as confirmed by TEM. Upon incubation with the target enzymes MMP-2/-9, a significant increase ($p < 0.05$) in both hydrodynamic size and PdI were observed, accompanied by pronounced morphological changes from spherical to worm-like interconnected structures. These findings confirm the enzymatic responsiveness of the system. The encapsulation efficiency of CHX within the nanomicelles was 36.7%. Furthermore, CHX-NM demonstrated

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antibacterial activity against *S. mutans* and *P. gingivalis*, reducing bacterial viability to approximately 25% at 6.25 μM and 4.37 μM, respectively, comparable to free CHX.

Conclusion: The engineered nanomicelles provide a clinically translatable, multifunctional platform for targeted and on-demand delivery of MMP inhibitors such as chlorhexidine, simultaneously achieving robust antimicrobial activity and effective MMP suppression. This dual-action approach addresses both bacterial burden and host-mediated tissue degradation, offering a promising strategy for improving therapeutic outcomes in infection-driven inflammatory diseases.

O-GlcNAcylation of Runx2 is critical for its interactome and vascular calcification

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Introduction: Vascular calcification (VC) is a hallmark of vascular aging and a critical driver of cardiovascular mortality in diabetes. While elevated protein O-GlcNAcylation is associated with diabetic VC, the specific molecular mechanisms remain elusive. We previously identified Runx2 as a master regulator of the "vascular/bone paradox." Here, we investigate how O-GlcNAc modification of Runx2 at Threonine 412 (T412) dictates its stability and osteogenic activity.

Methods: Coronary artery specimens from diabetic patients were analyzed via immunofluorescence. To determine causality, we generated a novel SMC-specific OGT knockout (smOGT-KO) mouse model induced with low-dose streptozotocin. Aortic calcification and stiffness were assessed via Arsenazo III and Echocardiography. To dissect the molecular axis, we employed site-directed mutagenesis (T412A), Co-Immunoprecipitation, and Mass Spectrometry-based proteomics to map the Runx2 interactome.

Results: We first demonstrated the co-localization of O-GlcNAcylation and Runx2 in human calcified diabetic lesions. In vivo, smOGT-KO markedly inhibited diabetes-induced vascular calcification and arterial stiffness compared to WT littermates. Mechanistically, we identified T412 as the primary O-GlcNAcylation site on Runx2. The T412A mutation significantly reduced Runx2 stability by enhancing ubiquitination-mediated degradation and disrupting Runx2-Smad4 binding. Our Mass Spectrometry analysis revealed a dramatic shift in the Runx2 interactome.

Conclusions: Our study provides the first genetic proof that SMC-specific OGT activity is a causative driver of diabetic VC. We demonstrate that **O-GlcNAcylation at T412** is a molecular switch that stabilizes Runx2 and enables it to recruit the protein complexes necessary for the VSMC-to-osteoblast phenotypic shift. Targeting the Runx2-T412 axis, potentially in coordination with the **FGF23/Klotho axis**, offers a promising precision therapeutic strategy to reverse vascular stiffness and systemic mineral imbalances in aging and diabetes.

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Session #2

Repurposing Approved Drugs to Target Cell Wall Integrity in Enterococcus faecalis

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Objectives: *Enterococcus faecalis* is a major contributor to persistent endodontic infections due to its capacity to form resilient biofilms and withstand harsh environmental conditions. UDP-N-acetylglucosamine enolpyruvyl transferase (MurA), a key enzyme in peptidoglycan biosynthesis, is essential for bacterial cell wall formation and represents a promising therapeutic target. This study aimed to repurpose FDA-approved drugs as MurA inhibitors and identify lead compounds capable of disrupting *E. faecalis* biofilm formation.

Materials and Methods: An *in silico* screening approach was conducted using the crystal structure of *Enterococcus faecium* MurA (PDB ID: 7TB0), a structural homolog of *E. faecalis* MurA. Molecular docking was performed with the active site centered at X: 24.31, Y: −23.85, Z: 33.58. A library of over 2,000 FDA-approved compounds was screened using ChimeraX and PyMOL. Candidates were ranked based on docking affinity and calculated lipophilicity (clogP). Two top-scoring compounds, Zopolrestat and VS-5584, were selected for experimental validation. Compounds were dissolved in DMSO and diluted to final solutions containing ≤2% DMSO to minimize solvent-related artifacts. *E. faecalis* V583 biofilms were grown in 96-well plates and treated with serial concentrations (0.001-100 μM). Planktonic growth was assessed by optical density at 600 nm, and biofilm biomass was quantified using crystal violet staining (λ=562 nm).

Results: Blind docking confirmed preferential localization of high-scoring compounds within the MurA catalytic pocket, validating grid definition. Zopolrestat and VS-5584 exhibited strong predicted binding affinities (-9.1 and -9.0 kcal/mol, respectively) and favorable physicochemical properties (clogP < 3). Both compounds reduced biofilm biomass in a dose-dependent manner. Significant inhibition was observed at 100 μM for Zopolrestat ($p<0.01$) and at 1 and 100 μM for VS-5584 ($p<0.01$) compared to untreated controls. Similar inhibitory trends were observed in planktonic cultures. Thirteen additional high-affinity candidates identified through in silico screening are currently undergoing microbiological evaluation.

Conclusion: This study identifies Zopolrestat and VS-5584 as promising MurA-targeting agents capable of suppressing *E. faecalis*biofilm formation. Notably, VS-5584 demonstrated significant activity at low micromolar concentrations, highlighting its therapeutic potential. These findings support drug repurposing as a viable strategy to target essential cell wall biosynthesis pathways in

persistent endodontic pathogens and justify continued screening to identify additional potent MurA inhibitors.

Support: Collins Medical Trust CMT-ASODO0221 (FSL), NIH-NIDCR R35-DE029083 (CSP)

Keywords: MurA; *Enterococcus faecalis*; Drug Repurposing; Molecular Docking; Biofilm Inhibition.

Designing precision peptides to manage Streptococcus mutans population.

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Dental caries is the most common disease in humans, with 91% of adults aged 20-64 years having experienced caries in their permanent teeth in the US. Streptococcus mutans is the most studied bacteria related to dental caries, known for being aciduric, acidogenic, and a great exopolysaccharide producer. Cationic and amphiphilic antimicrobial peptides (AMPs) act primarily on membrane permeability by forming pores that occasionally lead to cell death in a concentration-dependent manner. C16G2 and M8-33 peptides showed a strong targeting properties and antimicrobial activity. However, the amino acids sequence can be altered to induce higher affinities to SepM and ComD S. mutans' membrane proteins improving targeting and reducing peptide length. Here, we used molecular dynamics simulations to alter the C16 peptide sequence for better targeting. OpenMM and Rosetta Commons software were used to computationally analyze protein-peptide docking to score the best novel peptide designs to be synthesized and tested against single and multi-specie oral biofilms. The goal is to reduce S. mutans population and consequently multiple virulence factors such as exopolysaccharide matrix content and pH drop without disrupting the commensal microbiome. These novel peptides will be initially delivered by topical treatments. The translational potential option is to incorporate them into adhesives commonly used in dental restorations. The consequence may include oral microbiome population management to avoid a dysbiotic process, minimal impact on the microbiome, negative impact only on Streptococcus mutans strain even in presence of sugar. Mitigating S. mutans population may reduce dental caries prevalence or delay biofilm maturation.

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Session #2

Machine learning-aided SEM image analysis and bioluminescence assay for qualitative and quantitative assessments of Streptococcus mutans activity in antibacterial dental composites

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Objective & Significance: Bacterial recolonization following dental restoration is a primary cause of treatment failure, highlighting the need for dental composites with antimicrobial properties. In the development of such materials, *in vitro* characterization is a critical step. The aim of this study was to establish a multimodal approach for biofilm analysis, combining machine learning-based analysis of SEM images, a novel technique for imaging biofilm thickness, and assessment of metabolic activity using a luciferase assay.

Materials and Methods: Discs (10 mm diameter × 2 mm thickness) were prepared from a commercial resin composite (RC-Control; Filtek™ Bulk Fill Flowable Restorative, 3M ESPE), an antimicrobial resin composite control (RC-Antimicrobial Control; Lot No. 250129; Pulpdent Corporation, Watertown, MA, USA), an experimental antimicrobial resin composite (RC-Antimicrobial Experimental; Lot No. 250603; Pulpdent Corporation), and a glass ionomer cement (Equia Forte®, GC). The degree of conversion was measured by Fourier Transform Infrared Spectroscopy (FTIR; n = 10). Surface roughness was standardized using #2000 sandpaper and quantified with a Kairda KR310 Surface Roughness Tester (n = 10). Renilla-reporter *S. mutans* biofilms were grown on the discs under anaerobic conditions in sucrose-supplemented media. Metabolic activity was assessed at 1, 3, 6, and 24 h via luciferase assay, with bioluminescence measured using a GloMax® Discover Multimode Microplate Reader (GM3000, Promega). One disc per group was fixed in glutaraldehyde solution and imaged by SEM (Zeiss Sigma VP SEM) at 1kX, 5kX, and 20kX. Bars (12 mm x 5 mm x 2.5 mm) were prepared similarly, and 48-h biofilms were fixed for imaging. Biofilm surface coverage (%) was quantified using machine learning-based image analysis (Trainable Weka Segmentation) in Fiji/ImageJ (Version 21.0.7, NIH). Data were tested for homoscedasticity (Levene's test) and normality (Shapiro-Wilk test) before one-way ANOVA and Tukey's post hoc test ($\alpha = 0.05$).

Results & Discussion: The degree of conversion ranged from 46.7 ± 1.6% to 61.2 ± 0.27%, with the lowest values observed for RC-Antimicrobial Control. Surface roughness for all materials was within 0.2-0.3 µm. Bioluminescence assays of *S. mutans* growth showed average relative light unit (RLU) values of $1.79 \times 10^5 \pm 2.09 \times 10^4$ at 1h and $5.12 \times 10^6 \pm 4.51 \times 10^5$ at 6h. At 24h, bioluminescence further increased for RC-Control ($6.13 \times 10^6 \pm 1.39 \times 10^6$ RLU), whereas it

decreased for the other three materials, returning to values similar to those at 1h. SEM micrographs and quantitative image analysis demonstrated an increase in biofilm surface coverage from 0.2% at 1 h to 63.8% at 24h across all groups. RC-Control exhibited a substantial increase in biofilm area from 4.2% to 42.8% between 3h and 6h. In contrast, RC-Antimicrobial Control, RC-Antimicrobial Experimental, and Glass Ionomer groups showed markedly slower biofilm growth over the same period, with coverage increasing from 0.9% to 16.1%, 0.7% to 9.8%, and 4.9% to 15.1%, respectively. Analysis of cross-sectional biofilm thickness provided a comprehensive characterization of biofilm architecture and spatial development across materials.

Conclusion: This study presents a novel multimodal methodology that integrates bioluminescence assays, SEM imaging, and machine learning-based analysis to comprehensively evaluate bacterial adhesion and biofilm architecture on dental materials. By combining quantitative and visual approaches with cross-sectional imaging, this strategy enables precise, reproducible, and comparable assessment of biofilm development, offering a versatile platform for future studies of antimicrobial surfaces.

Fe/Zn-substituted hydroxyapatite loaded stimuli responsive chitosan hydrogel for periodontitis management

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Objective & Significance: Periodontitis is an oral inflammatory disease that affects 40% of the adult population. Current challenges in the treatment and monitoring of the disease contribute to suboptimal outcomes and an annual financial burden estimated at US$154 billion in the United States. To overcome this challenge, our ***goal*** is to develop and validate a thermosensitive, pH-responsive chitosan hydrogel loaded with iron- and zinc-substituted hydroxyapatite nanoparticles as a platform for periodontitis treatment and regeneration of damaged periodontal tissues.

Material & Methods: Iron (Fe) and zinc (Zn)-substituted hydroxyapatite (FZHA) nanoparticles were synthesized via a hydrothermal method and characterized by X-ray diffraction (XRD), zeta potential, particle size, and transmission electron microscopy (TEM) for morphology and aspect ratio. Subsequently, these nanoparticles were incorporated at concentrations ranging from 0 to 0.5 wt.% (FZHA-0, FZHA-0.1, FZHA-0.25, FZHA-0.5) into 4 wt.% chitosan solutions with β-glycerophosphate to form thermosensitive hydrogels at 37 °C. Hydrogel formation, injectability, and morphology were confirmed by tube inversion, rheological properties, scanning electron microscopy (SEM), and energy-dispersive X-ray spectroscopy (EDS) for elemental analysis (n=3). *In vitro* mineralization was assessed by incubating hydrogels in simulated body fluid (SBF) for 3 and 7 days, followed by SEM and EDS analysis of calcium and phosphorus content. Mechanical stability was evaluated *via* compressive strength testing; while swelling and degradation were monitored under physiological (pH 7.4) and periodontal-mimicking (pH 5.5, lysozyme-containing) conditions. Biocompatibility was assessed in human gingival fibroblasts (HGF) by Alamar Blue assay with hydrogel leachates collected over 14 days (n=6). Data were analyzed using one-way ANOVA followed by Tukey's post hoc test ($\alpha = 0.05$).

Results & Discussion: XRD analysis of the FZHA nanoparticles exhibited the characteristic peaks at 32- and 39-degrees confirming hydroxyapatite formation, with a **zeta potential** of 12.9 ± 0.361 mV and a hydrodynamic size of 966 ± 122 nm. **TEM** analysis showed the particles were a mixture of sheets and rods with mean length of 48 ± 21.6 nm and width of 16.2 ± 13.5 nm. FZHA hydrogels exhibited injectability capacity and adhesive properties, **SEM** analysis showed porous nature with average pore diameter from 40 to 60 µm. All the hydrogel groups except the FZHA-0 exhibited increase in calcium % after 7 days of incubation in SBF suggesting the FZHA nanoparticles facilitate ***vitro* mineralization**. The FZHA-0.25 hydrogel exhibited the highest **compressive strength** of ~19 kPa when compared to other groups. **Swelling kinetics** were higher in pH 5.5 when

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compared to pH 7.4 suggesting these hydrogels can swell rapidly in periodontal environment with acidic pH. Further to test their suitability for periodontal applications as a stimuli responsive platform, degradation **kinetics** was assessed in three different conditions. The results showed that in the presence of pH 5.5 + 10 µg/mL lysozyme, the hydrogels degraded rapidly with 100% degradation happening in groups FZHA-0 and FZHA-0.5, whereas in pH 7.4 the maximum degradation was around 12% (2 µg/mL lysozyme) and 16% (2 µg/mL lysozyme) further confirming the pH responsiveness of the designed platform. Finally, all the prepared hydrogel leachates exhibited > 90% **biocompatibility** irrespective of the nanoparticle concentration.

Conclusions & Takeaway: The hydrogel platform's responsiveness to periodontitis-mimicking conditions and its remineralization capability make it highly suitable for periodontitis management. Its combination of features, including an inexpensive natural polymer chitosan, Fe/Zn-substituted hydroxyapatite to enhance stability and mineralization, a thermosensitive hydrogel matrix, and pH and lysozyme responsiveness, both of which are abundant in the periodontal pocket, renders this system an ideal candidate for periodontal therapy with strong potential for clinical translation.

A commensal streptococcus competes a pathogenic Cohabitant Aggregatibacter actinomycetemcomitans by Type7 secretion system

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Introduction: Balanced biofilm composed with multispecies microbial communities of oral cavity is extremely important for human health. Commensal streptococcus parasanguinis and pathogenic *Aggregatibacter actinomycetemcomitans* have been found to coexist during the development of localized aggressive periodontal disease and interact in vitro and in vivo. More importantly, the relative abundance of each organism within the dual-species biofilm changes a lot. However, the molecular mechanisms of competing are poorly understood. The Type VII Secretion System (T7SS) is a specialized protein secretion system found mainly in Gram-positive bacteria, including Streptococcus, Staphylococcus, and Mycobacterium species. It plays diverse roles in bacterial survival, competition, and pathogenesis by secreting virulence factors.

Methods: Test the function of T7SS in S. parasanguinis and A. actinomycetemcomitans dual-species biofilm formation by knock out and overexpress T7SS associated genes.

Measuring Viability of S. parasanguinis and A. actinomycetemcomitans in co-cultures by serially diluted plate method and Immunofluorescence microscopy image.

Results: We found that T7SS is crucial for the competition between S. parasanguinis and A. actinomycetemcomitans. In addition, we identify LysM as a new T7SS substrate, which is encoded distantly from the T7SS gene cluster. Interestingly, too much or too less toxin secreted by S. parasanguinis is bad for the dual species biofilm formation. Fine-tuned production of appropriate concentrations of pathogenic A. actinomycetemcomitans promote S. parasanguinis biofilm formation.

Conclusions: Our study highlights a new association between Commensal streptococcus parasanguinis and pathogenic Aggregatibacter actinomycetemcomitans and reveals a magic mechanism to keep oral health through a commensal streptocuccs hijacks a pathogenic Co-habitant Aggregatibacter actinomycetemcomitans by T7 secretion system.

A dysbiotic bacterial community evades the mammalian immune system

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More than 700 species of bacteria have been found in the human oral cavity. The commensal oral microbiome community fills all available niches in the mouth ecosystem, making it difficult for pathogenic species to become established. Despite this, it is clear that oral microbes also contribute to many systemic or inflammatory diseases. Such microbes are not pathogenic, per se, as they coexist in the healthy mouth community, but when oral ecology is disrupted the resulting dysbiotic community is enriched for certain "inflammophiles" whose overgrowth is normally suppressed by the remaining members of the commensal community. In this project, we investigate both the interplay between the mammalian immune system and the transition to an inflammatory dysbiotic community. This inflammatory community in turn appears to influence the function of the mammalian immune system.

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Parvimonas manipulation of the host innate immune response through the manipulation of a master regulator of hypoxia contributes to the promotion of a pro-inflammatory feedback cycle.

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Introduction: *Parvimonas micra* is a pathobiont from the oral cavity that is strongly associated with mucosal dysbiotic disease, as well as multiple types of cancer. Inflammation is a hallmark of a number of oral diseases such as periodontitis, apical abscesses, and peri- implantitis. Despite a persistent inflammatory state at the sites of these oral infections, the host is unable to clear the infection. In these chronic and persistent infections, inflammophilic (loving or attracted to inflammation) microbes such as *P. micra* are enriched. We hypothesize that *P. micra* is a driver of inflammation through its manipulation of the host innate immune system.

Methods: Neutrophils (PMNs) were isolated from the peripheral blood of human subjects and *in vitro* studies with *P. micra* were performed.

Results: *Parvimonas* was able to induce the cellular migration of PMNs across transwell membranes. PMN infection by *Parvimonas* induced degranulation, leading to the release of cellular proteases which were able to cleave the extracellular matrix protein collagen. *Parvimonas* significantly induced transcription of the Hypoxia-inducible factor 1 (HIF-1) and cytokine IL-8 in PMNs. Further, production of IL-8 was partially dependent on HIF-1 activity.

Conclusions: Successful pathogens have the ability to manipulate host defenses to cause disease. The ability of inflammophiles to promote disease through manipulation of neutrophils, may reflect their success as drivers of chronic infections. Our results indicate that the inflammophile *Parvimonas* is especially adept at manipulating host inflammatory control mechanisms, and that this occurs through signaling pathways traditionally associated with hypoxia. These activities are critical for promoting an inflammatory positive feedback cycle. Studies exploring the nature of *Parvimonas* interactions with the host innate immune system will allow for a better understanding of the development and persistence of inflammatory diseases such as periodontitis, peri-implantitis, endodontic abscesses, as well as cancer.

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Session #2

Development of a versatile toolbox for genetic manipulation of Prevotella melaninogenica

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Introduction: The *Prevotella* genus is comprised of Gram-negative obligate anaerobes and is second-most abundant genus in the human oral microbiome. Although numerous clinical studies have linked various *Prevotella* species to both oral and systemic diseases as well as multiple cancers, our mechanistic understanding of *Prevotella* pathobiology is rudimentary, largely due to potent genetic intractability throughout the entirety of the *Prevotella* genus. To address this issue, we established an efficient genetic toolbox to manipulate clinical isolates of *Prevotella melaninogenica* that will support future genetic studies of its host-pathogen interactions.

Methods: *Prevotella melaninogenica* strains were isolated from clinical odontogenic abscess specimens on MCDC blood agar plates containing kanamycin and vancomycin. 16S rRNA genes sequencing was performed to verify the strains. PCR-assembled constructs were transformed into *P. melaninogenica* using natural competence.

Results: In this study, we isolated *Prevotella melaninogenica* strains directly from odontogenic abscess clinical specimens and identified multiple strains exhibiting natural competence (exogenous DNA uptake). By exploiting this ability, we were able to obtain transformation efficiencies up to 2.65×10^{-6} using mutagenesis constructs assembled via cloning-independent methodologies. Two negative selection systems functioning in *P. melaninogenica* were established based upon induced sensitivity to the 2-deoxy-galactose (2-DG) or sucrose. We also successfully employed codon-optimized version of the Green Renilla luciferase and HaloTag as highly sensitive reporter in *P. melaninogenica*. In addition, a novel regulated gene expression system was discovered in *P.melaninogenica*.

Conclusion: This study yields the first tractable genetic system in the *Prevotella* genus, which will provide new opportunities to systematically investigate *Prevotella* genetics, addressing a significant fundamental knowledge gap in the field.

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Epigenomics identifies multiple types and sources of DNA methylation in Streptococcus mutans UA159

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Abstract

DNA modifications (collectively termed the epigenome) play major roles in the physiology of all kingdoms of life and viruses. Compared to their roles in eukaryotes, DNA modifications and their effects are not as broadly understood and appreciated in bacteria, despite doubtlessly having major impacts on microbial communities and consequently, human health. Third generation sequencing technologies, such as Oxford Nanopore and PacBio, are revolutionary because they are able to detect DNA modifications at single-nucleotide resolution on a genome-wide scale. In this study, nanopore sequencing was used to detect DNA modifications in the model dental pathogen *Streptococcus mutans* UA159 at single-nucleotide resolution. This analysis identified 13,930 N6-methyladenosines (6mA) and one N4-methylcytosine (4mC) in the genome during log phase growth in THB media. As a proof-of-concept, the well-studied Type II restriction-modification system *dpnII* (SMU.504-506) was deleted, leading to the loss of 99.4% of the 9,601 m6A within the known DpnII recognition sequence GATC. All but one of the remaining 4,329 6mA were within the sequences CGANNNNNNNTCY/RGANNNNNNNTCA or CTGNAG/CTNCAG, suggesting at least two additional sources of methylation. CGANNNNNNNTCY and RGANNNNNNNTCA (reverse complements of each other) are reminiscent of the known bipartite recognition sequences of the Type I restriction-modification system *hsdI*, which is well-studied in other *Streptococcus* spp, but has not been studied in *S. mutans*. Indeed, deletion of the UA159 *hsdM* (SMU.891) homolog led to loss of 95% of the 1,246 6mA identified in within this motif. Deletion of SMU.43, annotated as a putative adenine-specific DNA methyltransferase, led to a loss of 99.9% of the 3,158 6mA within the CTGNAG/CTNCAG, thus defining this the role of this novel DNA modification enzyme and identifying the third source of 6mA in UA159. All deletion strains in this study (*ΔdpnII*, *ΔhsdM*, *Δ*SMU.43, *ΔdpnII*/*Δ*SMU.43, *ΔhsdM*/*Δ*SMU.43) displayed a reduced ability of *S. mutans* to inhibit the growth of neighboring commensal *Streptococcus* spp. Furthermore, deletion of *dpnII*, specifically, significantly reduced the ability of *S. mutans* to form biofilms. As biofilm formation and competition with commensal species are major virulence factors of *S. mutans*, these results support a role for the DNA modifications identified in this study in the ability of *S. mutans* to cause disease. Importantly, this study illustrates the power of nanopore sequencing to analyze bacterial epigenomes and the methods provide serve as a resource for the microbiology research community on how to conduct this type of analysis.

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Session #2

Effect of hyperglycemia and collagen properties on monocyte differentiation into macrophages

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Introduction: Diabetes mellitus (DM) is the most prevalent chronic disease in the U.S.. It is associated with impaired wound healing and increased cardiovascular and periodontal disease risk driven by inflammation. Under hyperglycemic conditions, collagen becomes stiffer due to non-enzymatic crosslinking by advanced glycation end-products (AGEs), reshaping extracellular matrix (ECM) remodeling and immune cell migration. Monocyte-derived macrophages orchestrate immune responses by adopting phenotypes that range from pro-inflammatory to pro-regenerative; however, how diabetes-induced ECM alterations influence this process remains unclear. This knowledge gap limits the development of immunomodulatory strategies to improve wound healing in DM. We hypothesize that glycated collagen primes monocytes to differentiate into pro-inflammatory macrophages, sustaining chronic inflammation. Our goal is to use tissue chips to determine how collagen glycation drives monocyte and macrophage fate.

Methods: To decouple glycation from other structural collagen changes, we used controlled gelation temperatures to warm-cast (37 °C, healthy-like) and cold-cast (4 °C, fibrotic-like) collagen. To simulate diabetic conditions, collagen was glycated with glucose at 5mM (physiologic) and 25mM (diabetic). THP-1 monocytes were activated with phorbol 12-myristate 13-acetate (PMA) and seeded in the lateral chambers of tissue chips to interact with type I collagen and assess 3D migration under chemotactic gradients. Collagen architecture was characterized using second harmonic generation imaging, and fiber and pore diameters were quantified. Macrophage phenotypes will be characterized by immunofluorescence using actin, pro-inflammatory (CD86) and pro-regenerative (CD206) markers. Quantification will be done using ImageJ and Imaris.

Results: Collagen characterization shows that cold-casting produces larger fiber and increased pore diameters than warm-casting. Monocytes display amoeboid migration primarily in fibrotic collagen. Under hyperglycemic conditions, collagen glycation is expected to alter macrophage spreading, adhesion, and phenotype.

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Conclusion: These findings suggest that early monocyte-ECM interactions governed by ECM mechanics influence macrophage fate. Hyperglycemia-induced collagen changes may disrupt migration and polarization, contributing to impaired healing. Understanding these mechanisms will support the design of immunomodulatory biomaterials that guide macrophages toward pro-regenerative phenotypes.

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Category STAFF

A Three-Year Review of the Biomaterials Synthesis and Characterization Core

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Steven Lewis, Matt Logan, Carmem Pfeifer, Jack Ferracane

Introduction: In 2022, the Pfeifer Polymers Lab within the Biomaterial & Biomedical Department in the School of Dentistry created a core facility to encourage the OHSU community, outside academic institutions and external companies to utilize our suite of instruments for materials and chemical characterization. The core directors and staff have over 30 years of experience in materials testing, engineering and data analysis. The core also provides project consultation, specimen preparation and testing services, and custom synthesis. This work highlights the Biomaterials Synthesis and Characterization Core capabilities, utilization, collaborations and publications over a 3-year period from 2023 – 2025.

Methods: The core is equipped with 9 state-of-the-art material characterization tools, including mechanical testing, spectroscopy and chromatography instruments. The core also specializes in coupled, real-time measurements, with an emphasis on mimicking physiologically relevant conditions. The iLabs online platform is used to track instrument utilization, allows users to make reservations, handles billing and generates internal reports.

Results: Since coming online, the core has provided as much as 900 hours of total instrument usage time per quarter. Instruments that have been utilized the most include the Universal Testing Machine (24%), Dynamic Mechanical Analyzer (18%), Rheometer (17%), Infra-red Spectrometer (15%) and Thermogravimetric Analyzer (9%). Numerous collaborations have been established outside SOD, including labs within Biomedical Engineering, KCRB, CEDAR, Interventional Radiology, Casey Eye Institute, and the OSU College of Pharmacy.

Conclusions: The Biomaterials Synthesis and Characterization Core has consistently provided vital services to researchers at OHSU over the past 3 years. The array of instruments, services and expertise has been critical to advancing innovative biomaterials research both within and outside the School of Dentistry.

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Session #2

A reassessment of orthodontic residents' demographics, values and opinions

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Co- Authors:
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Introduction: This study reassessed orthodontic residents' demographics, educational experiences, and future goals, and compared these with previously reported results.

Methods: An anonymous 41-question survey was distributed via e-mail to orthodontic residents in American and Canadian programs, according to Institutional Review Board-approved protocols. Wilcoxon and Fisher's exact tests were used to compare responses from females versus males and those with ≤$300,000 versus >$300,000 total educational debt, where $p<0.05$ defined significance. Current results were compared to previously published data to identify changes.

Results: Of 270 respondents, 61% versus 39% were female versus male and 39% versus 61% reported total educational debt of ≤$300,000 versus >$300,000. Respondents were aged 29±3 years, most were single (66%) and without children (88%). Female versus male respondents showed significant differences for age (female<male), single (female>male) versus married (female<male) status, children (female<male), importance of program costs (female<male) and diverse/inclusive environment (female>male) and plans to purchase and start a practice (female<male). Those with ≤ versus >$300,000 total educational debt showed significantly lesser importance for program costs, more support from family and less from financial aid, and lesser anxiety and influence on where-to-work due to debt. Survey results from 2003 to 2024 showed increases in female respondents from 38% to 61% and median total educational debt from $101,000-$150,000 to $301,000-$400,000.

Conclusions: Sex and level of estimated educational debt had significant effects on responses to some 2024 survey questions. For orthodontic residents in the USA and Canada, percentages of females compared to males and educational costs have increased with time.

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Post-space drying efficiency evaluated by standardized 3D-printed models.

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Introduction: Core build-ups are commonly used to restore endodontically treated teeth, and a post is particularly indicated when the remaining tooth structure is limited. Fiber-reinforced composite (FRC) posts reduce the risk of root fracture compared with metal posts; however, adequate adhesion is critical to prevent debonding. Residual moisture in post spaces can impair bonding, especially in long or narrow geometries, yet clinical drying techniques vary in effectiveness. The impact of post-space geometry on drying efficiency remains unclear. This study aimed to evaluate four post-space drying methods—air-syringe (AS), post-air-blow (PAB), paper-point (PP), and root-canal suction (RCS)—using standardized 3D-printed resin tooth specimens.

Methods: Maxillary central incisor models with post-space diameters of 1.4, 1.7, and 2.0 mm and lengths of 6, 9, and 12 mm were digitally designed and 3D-printed. Post spaces were filled with distilled water and dried using AS, PAB, PP, or RCS. Drying conditions simulated clinical procedures: AS applied coronal air for 10 s; PAB delivered air to the apical end via a 1-mm nozzle; PP used paper points until no visible moisture; RCS applied suction with gentle pumping for 10 s. Remaining moisture was measured gravimetrically and expressed as remaining-moisture amount (mg) and content (%). Two-way ANOVA assessed effects of post-space diameter and length per method; one-way ANOVA with Tukey's HSD resolved pairwise differences at fixed lengths. Nine specimens per condition were analyzed.

Results: Drying efficiency varied with both the method and post-space geometry. The air-syringe (AS) method consistently left the highest remaining moisture across all diameters and lengths. The post-air-blow (PAB) method was generally effective, but its performance decreased in long and narrow post spaces (12 mm × 1.4 mm). Paper-point (PP) and root-canal suction (RCS) methods showed the lowest and most consistent moisture levels; PP was slightly influenced by post-space length, whereas RCS exhibited minor effects of diameter only in short post spaces. Overall, longer post spaces and smaller diameters retained more moisture. Across conditions, the drying performance of PP was comparable to that of RCS, while AS resulted in higher residual moisture than PAB, PP, and RCS. PAB was intermediate overall but showed reduced efficiency in narrow and long post spaces. These results indicate that both the selected method and post-space geometry strongly influence residual moisture.

Conclusions: Post-space drying efficiency depends on both method and geometry. AS is insufficient for reliable moisture removal. PP and RCS provide consistent, effective drying, while PAB effectiveness decreases in long, narrow post spaces. The selection of a drying technique should account for post space length and diameter to minimize residual moisture, thereby optimizing conditions for adhesive cementation and post retention in clinical practice.

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Comparative Analysis of Novice Dental Students' Cavity Preparation Using Haptic Dental Simulators and Typodont Models

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Introduction: Haptic dental simulators integrate virtual reality with tactile feedback to create an immersive environment for preclinical training. By enabling repeated, risk-free practice, they represent a promising advancement in dental education. This study evaluated novice dental students' performance and perceptions of virtual-reality haptics (VR-haptics) compared with traditional typodont-based training in simulated Class I cavity preparations. Using quantitative performance metrics, the research examined VR-haptics' educational value, usability, and reliability as both a teaching and assessment tool.

Methods: Sixty-two first-year dental students with no prior cavity preparation experience voluntarily participated and were randomly assigned to Groups A and B. All students received a standardized one-hour lecture on Class I cavity preparation for resin composite restorations. Group A completed the typodont preparation first followed by VR-haptics, while Group B completed the tasks in the opposite order. Each participant began with a 15-minute practice session to develop handpiece control and tactile awareness using two outline forms (cross and round). Students then performed Class I preparations on tooth #29 using both modalities, completed a self-assessment rubric, and recorded preparation time. Two calibrated faculty members independently evaluated all preparations using the same rubric, and faculty scores were used to compare performance across modalities. Statistical analyses included paired or unpaired t-tests as appropriate, and inter-rater reliability was assessed using intraclass correlation coefficients (ICC). A p-value < 0.05 was considered statistically significant. All participants completed a post-experience survey administered through the Qualtrics platform (Provo, UT, USA) evaluating usability, realism, and self-assessment features.

Results: Faculty mean scores were comparable across modalities, indicating pedagogical equivalence. Inter-rater reliability was high in all groups, with VR-haptics demonstrating stronger evaluator agreement (Group A: ICC = 0.94; Group B: ICC = 0.88) than typodont assessments (Group A: ICC = 0.85; Group B: ICC = 0.82). All ICC values were statistically significant ($p < 0.001$), confirming strong reliability. Survey findings showed substantial student support for VR-haptics usability (81%) and educational value (81%), although perceptions of instrument realism and tactile fidelity were mixed. Self-assessment features received moderate endorsement, with 42% reporting VR-haptics as easier for reflective practice. Preparation times were similar between modalities, while evaluation times varied slightly by group and modality.

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Conclusion: VR-haptics serves as a reliable and effective complement to traditional typodont training in preclinical dental education. Its structured feedback, consistent scoring, and positive student reception support its integration into blended learning curricula. Continued improvements in tactile realism and self-assessment functions may further enhance its educational value. Future studies should examine long-term skill development and the transferability of VR-based training to clinical performance.

Anatomical Variations of the Axillary Artery

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Anatomical variation is a natural occurrence that reflects the diverse range of human anatomy (Alraddadi et. al, 2021). Thus, characterization of such variations is essential to better inform medical education and surgical intervention for various pathologies. Surveillance of 24 axillae across 12 anatomical donors revealed a high degree of variability within the axillary artery (AA), ranging from additional common trunks to bifid axillary arteries with atypical branching patterns; differences are particularly more evident in the second and third segments of the AA, consistent with previously reported findings (Langley et. al, 2020). Given that the AA is the primary blood supply of the upper extremity, understanding variations in this region can improve diagnosis and treatment, and minimize iatrogenic surgical injuries.

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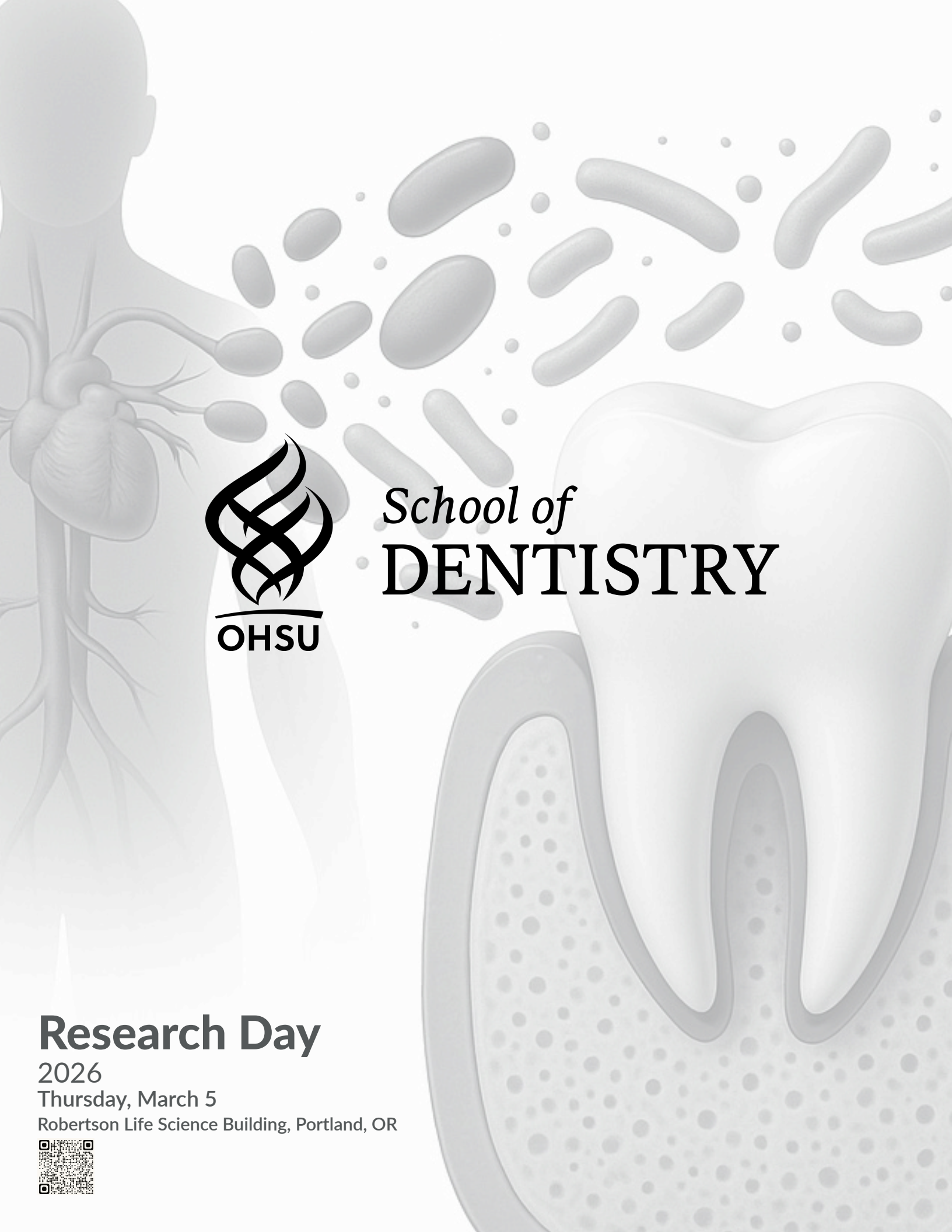

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