MARCH 1, 2024
Research Day

THE OHIO STATE UNIVERSITY
COLLEGE OF DENTISTRY
Office of Research
Schedule of Events

SPEAKERS PROGRAM
◊ Building A, Classroom 1180 (Livestream in Room 1160)

Opening Remarks
  John D. Bartlett, PhD | Associate Dean for Research  8:15 - 8:25 a.m.

Faculty Speaker Introduction
  Carroll Ann Trotman, BDS, MA, MS | Dean, College of Dentistry  8:25 - 8:30 a.m.

Faculty Speaker
  John D. Bartlett, PhD | Associate Dean for Research
  Title: The Surprising Role of Matrix Metalloproteinase-20 (MMP20) in Enamel Development  8:30 - 8:55 a.m.

Distinguished Lecturer Introduction
  John D. Bartlett, PhD | Associate Dean for Research  8:55 - 9:00 a.m.

Distinguished Lecturer
  Steven Chu, PhD | William R. Kenan, Jr. Professor of Physics, of Molecular and Cellular Physiology, and of Energy Science and Engineering at Stanford University
  Title: Climate Change and Innovative Paths Towards a More Sustainable Future
  1.5 CDE credits (all speakers) available for licensed practitioners  9:00 - 10:00 a.m.

ORAL & POSTER PRESENTATIONS

Poster Display
◊ Building B, Atrium and adjacent hallway  10:00 - 11:30 a.m.

Oral Presentations
◊ Building A, Classrooms 1160 & 1180  10:15 - 11:00 a.m.

AWARDS PRESENTATION

Dean’s Awards for Excellence in Research
◊ Building A, Lecture Room 1160
  Carroll Ann Trotman, BDS, MA, MS | Dean, College of Dentistry
  John D. Bartlett, PhD | Associate Dean for Research  4:30 - 5:15 p.m.
ORGANIZING COMMITTEE

Associate Dean for Research
John Bartlett, PhD

Director, Student Research Programs,
Advisor to Student Research Group
Scott Schricker, PhD

College Research Committee
Chairperson
Binnaz Leblebicioglu, DDS, MS, PhD

Research Day Planning & Support
Tina Adathakkar
Sherri Doughty
Emma Frey
Joen Iannucci, DDS, MS
William Johnston, PhD
Michelle Layana
Andrew Peters

Marketing & Communications
James Moulton, Web Communications Specialist
Tamra Steedman, Director
Bethany Waal, Graphic Designer

OHIO STATE DENTISTRY
STUDENT RESEARCH GROUP

President
Natalie Andras (DDS/PhD student)

Vice President
Daniel Fleming (DDS year 3)

Secretary
Aakriti Chaudhry (DDS year 4)

Treasurer
Shifa Shahid (PhD student)
Welcome to Research Day!

This annual event is a proud tradition that celebrates the scientific achievements made by our faculty and students as they uncover new knowledge in areas that include the microbiome, bone and muscle biology, psychoneuroimmunology, and oral cancer treatments using natural agents, to name a few. Our collective research efforts highlight our faculty members’ experience and expertise, and provide learning opportunities for students as we seek solutions for oral health-related issues that impact people throughout the world.

Research Day events also showcase discoveries made by internationally respected researchers, such as our distinguished lecturer, Stephen Chu, PhD. Dr. Chu is the William R. Kenan Jr. Professor of Physics, and Professor of Molecular and Cellular Physiology and Energy Science and Engineering at Stanford University. Throughout his career, he has served in a number of prestigious positions. He was the U.S. Secretary of Energy from 2009 to 2013, and in 1997 he was a Nobel Prize co-recipient for his work on laser cooling and optical trapping of atoms. As a world-renowned physicist, Dr. Chu’s scientific contributions include atomic fountain clocks and atom interferometers, the optical tweezers of biomolecules, and single molecule FRET of biomolecules tethered to surfaces. We welcome him as our distinguished lecturer and look forward to his presentation, “Climate Change and Innovative Paths toward a More Sustainable Future.”

Our faculty speaker this year is John Bartlett, MS, PhD, Professor in the Division of Biosciences and Associate Dean for Research. His work focuses on dental enamel development, and his laboratory is credited with discovering the first proteinase secreted into the enamel matrix. His presentation is titled “The Surprising Role of Matrix Metalloproteinase-20 (MMP20) in Enamel Development.”

This year’s Research Day includes oral and poster presentations by our dental and dental hygiene students, post-doctoral fellows, residents, and faculty — and awards will be presented.

Please join me in thanking Dr. John Bartlett and the Office of Research staff who organized this event that is an exciting and enlightening experience for our guests and everyone in the college community!

Carroll Ann Trotman, BDS, MA, MS
Professor and Dean
Welcome from the Associate Dean for Research

As the Associate Dean for Research, it is my pleasure to welcome you to the College of Dentistry’s 40th annual Research Day! This event celebrates our students’, staff’s, and faculty members’ commitment to research pursuits, and it also provides an opportunity for us to learn about each other’s research interests.

Many of our faculty have graciously taken the time to judge student presentations for the Research Day Awards Ceremony. Dean’s Awards will be presented for the best research projects for the top three DDS students, top three graduate students/residents, and for the top hygiene student and top undergraduate student.

Research Day prepares our students and postdoctoral fellows for national and international competitions, including several sponsored by the American Association of Dental, Oral and Craniofacial Research (AADOCR) or International Association for Dental Research (IADR). Top presenters qualify to compete at the AADOCR/Dentsply Student Clinical Program and the nationally recognized Hinman Student Dental Research Symposium.

Additionally, awards are generously presented by Dentsply Sirona and the AADOCR. Moreover, faculty researchers are honored by the College of Dentistry with Paper of the Year Awards for Basic Research, Clinical Research, and Social and Behavioral Sciences & Public Health Research.

This year, John D. Bartlett, PhD, is our Research Day faculty presenter. He is a Professor in the Division of Biosciences and is the Associate Dean for Research. The Bartlett research group discovered the first proteinase secreted into the enamel matrix and named it enamelysin (matrix metalloproteinase-20, MMP20). Additionally, his group co-discovered kallikrein-related peptidase-4 (KLK4), which is also secreted into the developing enamel. Dr. Bartlett is actively involved in research focused on how proteinases facilitate enamel development. He is the recipient of the 2012 International Association for Dental Researchers (IADR) Distinguished Scientist Award for Basic Research in Biological Mineralization and he received the 2018 IADR Distinguished Scientist Award for Pharmacology/Therapeutics/Toxicology. He has had continuous National Institutes of Health funding since 1997. His talk title is, “The Surprising Role of Matrix Metalloproteinase-20 (MMP20) in Enamel Development”.

We are thrilled to welcome Professor Steven Chu as our Distinguished Keynote speaker for our college’s 40th Research Day. Dr. Chu is the William R. Kenan, Jr. Professor of Physics, of Molecular and Cellular Physiology, and of Energy Science and Engineering at Stanford University. He earned his Ph.D. in physics from the University of California, Berkeley and, surprisingly, he has also received 35 honorary degrees. From 2004-2009, he was the director of the Lawrence Berkeley National Laboratory and Professor of Physics and of Molecular and Cell Biology at the University of California Berkeley. From January 2009 to April 2013, Dr. Chu served as U.S. Secretary of Energy under President Barack Obama and he was personally tasked by President Obama to help stop the BP Oil leak. With Professor Chu at the helm, the energy department implemented funding for renewable energies as part of the president’s 2009 economic stimulus, which was tasked with redirecting the country’s energy consumption away from traditional fossil fuels. Professor Chu has received many awards, including co-award of the 1997 Nobel Prize for laser cooling and optical trapping of atoms. The title of his Research Day presentation is, “Climate Change and innovative paths towards a more sustainable future”.

Please join me in extending a sincere thank you to the faculty, staff, and students whose efforts have made this Research Day possible. Good luck to the participants, and my sincere thanks to all of you for joining this event.

John D. Bartlett, PhD
On behalf of The Ohio State University College of Dentistry Research Committee, I welcome you to Research Day 2024. I am excited to have this special day at our school this year. This reminds me my years as a graduate student when this event took place on the 3rd floor of the current Postle Hall A, in the hallways between research laboratories. We were shoulder to shoulder, always bumping into each other, sweaty and nervous but very happy to be there presenting our work. I vividly remember our faculty passing through the posters, distributing our awards and OSU COD pins. I still wear mine on special occasions.

There is no doubt that there are significant differences between that old venue and the new, bright, and spacy atrium at Postle Hall B. We are looking forward to hosting our entire college community in our new building, to celebrate our students’ achievements in research and, to learn about some of the inspiring work happening within our school.

One more time, a special scientific program has been prepared for this year’s Research Day. Our Keynote Distinguished Speaker is a Nobel laureate Dr. Steven Chu who is the William R. Kenan Jr. Professor of Molecular and Cellular Physiology and of Energy Science and Engineering at Stanford University. Dr. Chu also served as U.S. Secretary of Energy under President Barack Obama and was personally tasked by President Obama to help stop the undersea BP Oil leak. He is a dynamic speaker, and his talk will be about climate change.

Our own faculty Dr. John Bartlett will be our faculty speaker. Other than being our Associate Dean for Research, Dr. Bartlett is a well-known researcher in the field of dental enamel development receiving continuous research support from National Institute of Dental and Craniofacial Research (NIDCR), Forsyth Institute, Colgate-Palmolive, Harvard School of Dental Medicine, and The Ohio State University. His research team discovered the first proteinase secreted into the enamel matrix and named it as enamelysin. Dr. Bartlett received several research and distinguished scientist awards from Journal of Dental Research and International Association of Dental Research (IADR) throughout his academic career. We are very grateful that he accepted to become this year’s speaker. We are also thankful for the amazing work he and his team at the Office of Research are accomplishing in organizing such a great event.

I also want to share exciting news: Thanks to Dr. Bartlett and his team’s efforts, the AADOCR Columbus Ohio Section will be reactivated this year during the annual scientific meeting. This will allow our active participation in the organization’s governance.

Research Day has been a key component of our dental curriculum since the beginning. We cannot wait to share the excitement and enthusiasm of clinical and bench type research conducted within our college by the help of dedicated mentors. Please join me to support our young investigators and to spend a day full of new knowledge in dental research.

Binnaz Leblebicioglu DDS, MS, PhD
Professor, Chair of the College of Dentistry Research Committee
Welcome from the Student Research Group (SRG) President

As President of the Student Research Group at The Ohio State University College of Dentistry, I am excited to invite you to our annual Research Day. This event provides the opportunity for dental students, graduate students, post-doctoral fellows, residents, and faculty to showcase their research and be recognized for their extraordinary effort and dedication to science. Additionally, we are grateful for the opportunity to hear from the world’s most renowned scientists who have generously given up their time to present their remarkable advancements in oral health research.

This year’s Keynote Distinguished Speaker, Steven Chu, PhD, is a Nobel laureate and Professor of Molecular and Cellular Physiology and of Energy Science and Engineering at Stanford University. His research investigating laser cooling and optical trapping of atoms and particles, atomic fountain clocks and atom interferometers, and single molecule FRET of biomolecules is an intersection of biophysics, molecular and cellular physiology, and medical particle synthesis. Dr. Chu will provide an inspiring presentation on his international work on climate change.

We also have the privilege of hearing from John Bartlett, PhD, as this year’s faculty speaker. Dr. Bartlett is a Professor in the Division of Biosciences and serves as the Associate Dean of Research for the College of Dentistry. His research focuses on deciphering dental enamel development and the molecular mechanisms driving tooth formation. Dr. Bartlett will provide an exciting presentation on matrix metalloproteinase-20 (MMP20), a protein his lab discovered early in his academic career, and its roles in enamel development.

Research Day gives all students an opportunity to receive valuable feedback from peers, senior researchers, and distinguished faculty. The oral and poster presentations given today prepare our students for national research competitions of the International Association for Dental Research/American Association for Dental, Oral, and Craniofacial Research (IADR/AADR), Dentsply Sirona/AADOCR Student Competition for Advancing Dental Research and its Application (SCADA), and the Hinman Student Research Symposium. Those recognized for their outstanding presentations will be awarded at our annual celebratory reception.

Please join me in thanking Dr. John Bartlett, Associate Dean of Research, and the Office of Research staff members who help make this event possible every year. They have dedicated a remarkable amount of time and effort in preparing an exceptional program, which provides us all with an inspiring and meaningful experience.

Good luck to all participants, and thank you for joining us at this event!

Natalie L. Andras
DDS/PhD Candidate

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Good luck to all participants, and thank you for joining us at this event!

Natalie L. Andras
DDS/PhD Candidate
About Our Faculty Speaker

John D. Bartlett, MS, PhD,
is a tenured professor in the Division of Biosciences and he is the College of Dentistry’s Associate Dean for Research. Dr. Bartlett’s research is focused on understanding dental enamel development. Specifically, his lab discovered the first proteinase secreted into the enamel matrix. He named it enamelysin (matrix metalloproteinase-20, MMP20). Moreover, his lab co-discovered the only other proteinase known to reside in dental enamel. This proteinase was originally named “enamel matrix serine proteinase-1,” but was renamed kallikrein-related peptidase-4 (KLK4). Inactivating mutations in either MMP20 or KLK4 causes severe enamel malformation in both humans and mice.

Dr. Bartlett has published more than 135 peer-reviewed papers, reviews and book chapters and he has approximately 11,000 citations to his published work (https://scholar.google.com/citations?hl=en&user=EPgbOTsAAAAJ). Among these publications is a book chapter on MMP20 published in the Handbook of Proteolytic Enzymes (Academic Press) and a “Discovery” article in the Journal of Dental Research (J Dent Res. 2005 84(11):986-988) about the events leading to the discovery of MMP20.

Since 1997, Dr. Bartlett has had continuous National Institutes of Health funding through the National Institute of Dental and Craniofacial Research. He has also received funding from the Forsyth Institute, Colgate-Palmolive, the Harvard School of Dental Medicine, and The Ohio State University.

Dr. Bartlett has been awarded several research honors including the William J. Gies Award for the best Biological Research paper published in the Journal of Dental Research during the previous year (J Dent Res. 93:1022-7, 2014). He also received two Distinguished Scientist Awards from the International Association of Dental Research. One for Basic Research in Biological Mineralization (2012) and the other for Pharmacology/Therapeutics/Toxicology Research (2018). His research pursuits were highlighted in the American Association of Dental Research’s “Strides in Science,” February 14, 2013.

Therefore, Dr. Bartlett has made seminal discoveries into the molecular mechanisms necessary for proper dental enamel formation, and we are excited to learn about his insights about the role MMP20 plays in this process during his research day presentation titled, “The Surprising Role of Matrix Metalloproteinase-20 (MMP20) in Enamel Development.”
Steven Chu, PhD, is the William R. Kenan, Jr. Professor of Physics, of Molecular and Cellular Physiology, and of Energy Science and Engineering at Stanford University. He earned his Ph.D. in physics from the University of California, Berkeley.

From 2004-2009, he was the director of the Lawrence Berkeley National Laboratory and Professor of Physics and of Molecular and Cell Biology at the University of California Berkeley. Prior to those positions, he was the Theodore and Francis Geballe Professor of Physics and Applied Physics at Stanford University. During this time, he helped start Bio-X, a multi-disciplinary initiative at Stanford combining the physical and biological sciences with engineering and medicine.

From January 2009 to April 2013, Dr. Chu served as U.S. Secretary of Energy under President Barack Obama. During his tenure, he began several initiatives, including ARPA-E (Advanced Research Projects Agency – Energy), the Energy Innovation Hubs, and the Clean Energy Ministerial meetings. As the first scientist Cabinet member, Dr. Chu recruited dozens of outstanding scientists and engineers to the Department of Energy, and was personally tasked by President Obama to help stop the BP Oil leak. With Dr. Chu at the helm, the energy department implemented funding for renewable energies as part of the president's 2009 economic stimulus, which was tasked with redirecting the country’s energy consumption away from traditional fossil fuels.

His scientific contributions include the introduction of laser cooling and optical trapping of atoms and particles, atomic fountain clocks and atom interferometers, the optical tweezers of biomolecules, and single molecule Förster resonance energy transfer (FRET) of biomolecules tethered to surfaces. His current research is in biophysics, molecular and cellular physiology, medical imaging, nanoparticle synthesis and battery research.

Dr. Chu is a member of the National Academy of Sciences, the American Philosophical Society, the American Academy of Arts and Sciences, National Academy of Inventors, and a foreign member of the Royal Society, the Royal Academy of Engineering, the Chinese Academy of Sciences, the Academia Sinica, the Korean Academy of Sciences and Technology and the Pontifical Academy of Sciences.

Dr. Chu has received approximately 40 awards, including being a co-winner of the 1997 Nobel Prize for laser cooling and optical trapping of atoms. He was also awarded the Gordon Moore Lifetime Innovation Award (2019), the Golden Plate Award of the American Academy of Achievement (1998), the Humboldt Prize by the Alexander von Humboldt Foundation (1995), and he is a past president of the American Association for the Advancement of Science. Significantly, Dr. Chu is the recipient of 35 honorary degrees including those from Ivy Leagues such as Harvard, Dartmouth, and Yale.
Committees and Judges

Our sincere appreciation to our Research Committee

Dr. Ehsan Azadani  Dr. Justin Kasper  Dr. Peter Reiser
Dr. John Bartlett, Ex-officio  Dr. DoGyoon Kim  Dr. Scott Schricker, Ex-officio, non-voting
Dr. Clifford Beall  Dr. Binnaz Leblebicioglu, Chair
Dr. Melissa Drum  Ms. Kazune Pax, DDS/PhD student
Dr. Hany Emam  Dr. Sarah Peters

And to our distinguished judges for graciously volunteering their time and expertise for this event

Dr. Rafat Amer  Dr. Salam Hetou  Dr. Peter Reiser
Dr. Cliff Beall (presenting, poster)  Dr. Yuan-Lynn Hsieh  Dr. Kedith Sawangsri
Ms. Beth Chartier  Ms. Rachel Kearney  Dr. Scott Schricker
Dr. Hong Chen  Dr. Do Kim  Dr. Shilpa Shah
Dr. Xi Chen (presenting, oral)  Dr. Tom Knobloch  Dr. John Sheridan (Oral only)
Dr. James Cottle  Dr. Ching-Chang Ko  Dr. Diana Smyres
Dr. Robert Davidson  Dr. Kyulim Lee (presenting, oral)  Dr. Dawne Stefanik
Dr. Melissa Drum  Dr. Diana Leyva del Rio  Dr. Zhong Sun
Dr. Tammy Duangthip  Dr. Susan Mallery  Dr. Dimitris Tatakis
Dr. Brian Foster (presenting, poster)  Dr. Debbie Mendel  Dr. Janice Townsend
Dr. Sara Fowler  Ms. Denise Messina  Dr. Joe Travers
Dr. Ann Griffen  Dr. Mark Morrison  Dr. Susan Travers
Dr. Hanin Hammoudeh  Dr. Leonardo Nassani  Dr. Bob Uhlin
Ms. Becky Henderson  Ms. Irina Novopoltseva  Dr. Andrea Zandonna
Dr. Sarah Peters
The College of Dentistry’s 39th Annual Research Day, held on February 24, 2023, featured undergraduate, dental and dental hygiene students, pre-doctoral students, postdoctoral fellows, and residents who presented abstracts on an array of cutting-edge research topics. The event included poster displays where researchers presented their findings for judges and other interested individuals.

Included in the awards for the 2023 Student Research Competition was the AADOCR/Dentsply SCADA Award cosponsored by Dentsply Sirona and the American Association for Dental, Oral and Craniofacial Research (AADOCR). The winner of this award qualified for entry into the national Student Competition for Advancing Dental Research and its Application at the annual AADOCR General Session. The 2023 SCADA Award winner was Natalie Andras.

The second-place award for the Student Research Competition is the Alumni Research Merit Award. The winner of this 2023 award qualified for entry into the Hinman Student Research Symposium competition, with support from the Thomas P. Hinman Dental Society, the AADOCR, and Procter & Gamble. The 2023 Alumni Research Merit Award winner was Kazune Pax.

The third-place award for student researchers is the Alumni Research Achievement Award. The winner is qualified to enter the Hinman Student Research Symposium competition. The 2023 Alumni Research Achievement Award winner was Nathan Kim.

The following recipients were chosen as winners of the 2023 Dean’s Award for Excellence in Research for their innovative projects. Alexis Powers, Nathan Kim, and Aakriti Chaudhry won the first-, second-, and third-place Dental Student Awards. Alexis Powers won the AADOCR Research Day Award. Gene Park won first-place and Lily Etemad was awarded second with Natalie Andras taking third place for the Graduate Student Awards. Fatma Mohamed received the Postdoctoral Fellow Award. The first-place Hygiene Student Award went to Joseph Osborne and Robert Bettinger received the first place Undergraduate Student Award. Robert Bettinger also won the award for the CCTS Best Clinical and Translational Abstract.*

*This award is sponsored by The Ohio State University Center for Clinical and Translational Science.
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Repeated Social Defeat Alters Characteristics of Bone

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OBJECTIVES
Repeated psychosocial stresses such as bullying or low socioeconomic status can result in an immune-enhanced, pro-inflammatory state. A murine repeated social defeat (RSD) model is a stressor that recapitulates key physiological, immunological, and behavioral alterations observed in humans exposed to psychosocial stress. We hypothesize that the RSD, coupled with the increased pro-inflammatory cytokines, could readily result in increased bone resorption cell (osteoclast) formation and activity. Thus, the objective of this study was to examine whether RSD alters the characteristics of bone.

METHODS
Following approval from the IACUC, 12 male C57BL/6 (6–8 weeks) and CD-1 (12 months) mice were obtained. The aggressive male intruder CD-1 mouse was introduced into cages of established male cohorts (3 per cage) of C57BL/6 mice for 2-hour hours during 6 consecutive nights. The control 3 C57BL/6 mice in a cage were undisturbed. Spleen, mandibles, femurs, and blood were collected 14 hours after the last cycle of stress. The bone specimens were subjected to scanning by a micro-computed tomography with 10×10×10 µm³ voxel size. Bone voxels were digitally segmented from non-bone voxels. Histograms for tissue mineral density (TMD) were obtained to compute mean, standard deviation (SD), fifth percentile low (Low5), and high (High5) TMD values for each sample. Morphological analysis was conducted using the segmented bone voxels. A t-test was used to compare the TMD and morphological parameters between control and RSD groups. Significance was set at p<0.05.

RESULTS
The RSD group had significantly higher values of spleen weight and osteoclast biomarkers (TRAP and CTX), while values of TMD mean, Low, and High5, trabecular number, growth plate thickness and volume were lower than the control group (p<0.05).

CONCLUSION
The current results indicate that RSD activates osteoclast-mediated bone resorption resulting in a reduction of bone quantity parameters.
**Induced periodontitis in 3xTG mice increases neuronal inflammatory responses**

**OBJECTIVES**
Periodontal disease (PD) is an aging disease in which chronic inflammation leads to bone and tooth loss in 20-50% of the global population. Alzheimer’s disease (AD) is the most common form of dementia in aging adults. Several studies have found a positive correlation between AD and PD, but the mechanisms underlying their relationship remain unclear. We hypothesized that inflammation associated with periodontitis could exacerbate AD progression and that the AD predisposition may similarly exacerbate periodontitis symptoms.

**METHODS**
We induced periodontitis in transgenic AD (3xTg-AD) and WT mice with a silk ligature tied around the right second maxillary molar. Ligatures were kept for 7 or 14 days, after which we assessed bone loss with microcomputed tomography postmortem. Levels of hippocampal inflammatory cytokines and neuronal receptors were measured using RT-PCR. Novel location memory and novel object memory behavioral tests were also completed.

**RESULTS**
WT and AD mice showed no differences in bone loss at both 7 and 14 days. The non-ligature side showed minimal bone loss in both genotypes. qPCR data indicated an increase in inflammatory cytokine gene expression in the hippocampus of AD mice as compared to WT mice. There was also a significant decrease in gene expression of glutamate receptors and synaptic elements in the AD hippocampus after ligature placement. Novel location and object memory were impaired only in the AD mice receiving ligatures.

**CONCLUSION**
AD does not predispose mice to increased PD destruction. Ligature-induced bone loss in AD mice led to exaggerated hippocampal neuroinflammation and synaptic dysregulation. Behavioral analysis suggests that comorbidity of PD and AD in mice results in more significant memory impairment than AD alone. Future studies are planned to determine the mechanism that links PD with AD and other neurodegenerative diseases.
Radiographic Craniofacial Findings of Cleidocranial Dysplasia: A Systematic Review and Meta-Analysis

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OBJECTIVES
Cleidocranial Dysplasia (CCD) is a rare genetic disorder characterized by skeletal and craniofacial abnormalities. CCD affects teeth and bones, such as the skull. This study aims to focus on the prevalence, characteristics, and heterogeneity of craniofacial abnormalities in CCD using the radiograph findings.

METHODS
We systematically searched major databases such as PubMed, Web of Science, Scopus, and Cochrane Library. Eligibility criteria focused on studies reporting craniofacial features with X-RAYS such as: Panoramic, lateral cephalometric in CCD patients. Statistical analysis involved pooling the prevalence of the different radiological features among patients included in the study. Data analysis was done using Rstudio (Version 4.2)

RESULTS
The study included a total of 12 observational studies. Our study revealed high prevalence rates for several craniofacial features. Late exfoliation of deciduous teeth exhibited a high prevalence of (85%, 95% CI [85%, 98%], I² = 0%). Supernumerary teeth were prevalent at (87%, 95% CI [70% to 95%], I² = 78%). Impacted permanent teeth demonstrated a striking prevalence of (99%, 95% CI [73% to 100%], I² = 0%). Wormian bone had a high prevalence of (99%, 95% CI [68% to 100%]). Hypoplastic midface exhibited (87%, 95% CI [57% to 97%], I² = 86%). Mild hypertelorism was prevalent at (98%, 95% CI [24% to 100%], I² = 0%) and delayed closure of cranial sutures at (94%, 95% CI [83% to 98%], I² = 0%). Open fontanels were at (92%, 95% CI [82% to 96%], I² = 0%), while frontal bossing had (91%, 95% CI [40%, 99%], I² = 78%)

CONCLUSION
This study provides an overview of CCD’s radiographic manifestations, shedding light on the prevalence and characteristics of craniofacial features. These findings contribute vital insights into understanding CCD’s radiological profile.
Effects of Postmenopausal Osteoporosis on Bone Sialoprotein Levels and Alveolar Bone Healing

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OBJECTIVES
Postmenopausal osteoporosis (PO) stems from osteoblast (OB)-osteoclast (OC) decoupling. Bone sialoprotein (BSP) is a multifunctional protein found in bone, and global ablation in mice results in impaired alveolar bone mineralization and healing. Treatments designed to reduce bone loss in PO decrease serum BSP; however, it is unclear why BSP is reduced and how these changes impact periodontal homeostasis. We hypothesized serum changes in BSP reflect increased bone resorption in PO mice and impairs alveolar bone healing. We further hypothesized that exogenous BSP would improve alveolar bone healing in PO mice.

METHODS
At 6-weeks, 129S1/SvImJ mice underwent sham or ovariectomy (OVX). Eight-weeks post-surgery, mice underwent bilateral maxillary first molar extractions and received either no treatment, collagen gel, or collagen+BSP gel into the extraction socket (n=4-6/group/treatment). At 21 days post-extraction, maxillae and long bones were collected. Serum at baseline and endpoint was analyzed by ELISA, and tissues were analyzed by micro-computed tomography and histology.

RESULTS
OVX mice possessed increased weight (p=0.0072), reduced bone volume fraction (BV/TV) (p=0.0034) and reduced trabecular number (p=0.0028), which indicated successful induction of PO. Serum levels of BSP trended toward being increased in OVX mice (p=0.0897). Surprisingly, CTX-I (bone resorption) was unchanged between sham and OVX (p=0.5031); however, P1NP (bone formation) was significantly increased in OVX mice (p=0.0005). TRAP staining indicated increased osteoclast numbers in sockets of OVX mice receiving collagen or collagen+BSP. Healing alveolar bone BV/TV and BMD were reduced in mice receiving no treatment (p=0.0429 and 0.0192, respectively) and collagen gel (p=0.0255 and 0.01); however, there was no difference for either parameter in mice receiving collagen+BSP gel (p=0.1861 and 0.1541).

CONCLUSION
In mice with PO, serum BSP trended toward being increased, which correlated with increased P1NP, not CTX-I. Compared to mice receiving no treatment or only collagen gel, alveolar bone healing was slightly improved following the addition of collagen+BSP.
Midpalatal Suture and Dentition: Murine Response to In Utero Citalopram

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OBJECTIVES
Maternal depression during pregnancy, is commonly pharmacologically managed with antidepressants, including Selective Serotonin Reuptake Inhibitors (SSRIs). The aim of this study was to investigate the effects of in utero SSRI exposure on the midpalatal suture and dentition in a murine model.

METHODS
Wild type C57BL6 mice were used to produce in utero exposed litters, simulating fetal SSRI exposure (generic name Citalopram) exposure. Citalopram was added to the drinking water of pregnant dams (~500 μg/day) from embryonic day 13 (E13) to E20 to mimic a scaled clinically relevant dose of citalopram in humans. Resultant offspring were grown to postnatal day 15 (P15) and then sacrificed. Skulls were fixed in 4% paraformaldehyde and then underwent microcomputed tomography in 70% ethanol. For cephalometric analysis, 3D reconstructions of skulls were generated with CTVox software v2.3.0 r810 (Skyscan) and measured using Analyze Pro and 3D slicer software. We utilized representative samples from our group of citalopram-exposed (n = 25) and unexposed (n = 25) mice. Currently, these samples are under investigation to assess potential cellular variations attributed to exposure, as detected through histological analysis.

RESULTS
Pre-natal exposure to a clinically relevant dose of citalopram resulted in overall changes in murine craniofacial structures. More specifically, palate length and width decreased in SSRI exposed pups as compared to control un-exposed pups. The effects of SSRI on the molars were minimal. Cellular based investigation of the mid-palatal suture is ongoing.

CONCLUSION
Craniofacial growth and development remain areas of interest in investigating in utero pharmaceutical drug exposure. Collectively, this data indicates that prenatal SSRI exposure affects craniofacial form in various tissues, particularly at growth sites and centers of the skull. The exact mechanism is yet to be determined.
Fungi and Bacteria Invade Dentin Separately In Advanced Caries

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Dental caries is a prevalent disease of childhood with a major impact on health and quality of life. Although bacteria, including especially Streptococcus mutans are known to be major contributors to caries, fungi of the genus Candida also play a role. On the tooth surface fungi and bacteria have been found to form mixed kingdom biofilms during early caries. In this work we examine the distribution of fungi and bacteria in caries lesions in children by next generation sequencing of the bacterial 16S rRNA gene and the fungal ITS2 sequence, real-time PCR, histology and immunohistology, and scanning electron microscopy. We find that the ratio of fungi to bacteria in advanced dentin lesions is higher than in earlier caries stages and that the bacteria and fungi tend to reside in separate dentin tubules. The sequencing combined with qPCR identified bacterial species that increased in dentinal lesions as opposed to intact enamel. These included Streptococcus mutans, other Streptococcus species, the Veillonella parvula group, Prevotella species, lactobacilli, and Actinomycetota (formerly Actinobacteria) species. The fungal species that increased were Candida albicans, dubliniensis, and tropicalis. We conclude that Candida may play an important role in the invasion of early childhood caries into the dentin.
The Role of the Bone Sialoprotein RGD-Domain in Dentoalveolar Development and Repair

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OBJECTIVES
Bone sialoprotein (Ibsp gene; BSP protein) is a multifunctional, extracellular matrix protein found in mineralized tissues. In mice, deletion of Ibsp (Ibsp−/−) leads to reduced acellular cementum, alveolar bone resorption, and PDL destruction. While the consequences of global BSP ablation in the craniofacial skeleton have been defined, the underlying mechanism(s) remain unclear. This is due, in part, to outstanding questions regarding the contributions of BSP functional domains to dental development. BSP contains an RGD integrin-binding domain, which mediates cell attachment and signaling as well as osteoblast/osteoclast differentiation/function via the ☐v☐3 integrin. Previous studies on the BSP-RGD domain have been limited to in-vitro studies. We engineered a transgenic mouse wherein the BSP-RGD domain is rendered inactive via replacement with a nonfunctional KAE sequence (IbspKAE/KAE). We hypothesized inactivation of the BSP-RGD domain would negatively affect dentoalveolar development and alveolar bone healing.

METHODS
To analyze dentoalveolar development, mandibles were harvested from 42 and 90 days-post-natal (dpn) IbspKAE/KAE and wild-type (WT) mice (n=6-8/genotype/timepoint) on a 129 background. To analyze bone repair, bilateral maxillary first molar extractions were performed at 42 dpn and alveolar bone healing was analyzed at 21-days-post-extraction (dpe) (n=5-6/genotype). Tissues were analyzed by micro-computed tomography, histology, and immunohistochemistry.

RESULTS
Inactivation of the BSP-RGD binding domain did not negatively affect enamel, dentin, or alveolar bone volumes or mineral densities. Acellular cementum was present, PDL fiber organization was undisrupted, and periodontal breakdown was not observed. Alveolar bone healing experiments showed no significant differences in bone volume fraction (BV/TV) or bone mineral density (BMD) in IbspKAE/KAE vs. WT controls.

CONCLUSION
Inactivation of the BSP-RGD domain did not cause defects in dentoalveolar development or alveolar bone repair. These results suggest either the BSP-RGD domain is not essential for dentoalveolar development and alveolar repair or other factors and/or mechanisms may compensate for BSP-RGD inactivation.
Site-Specific Effects of Exercise on Bone Health with High Phosphate

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OBJECTIVES
A processed food diet can elevate serum inorganic phosphate (PI) levels, which may lead to adverse cardiovascular complications, chronic kidney disease, and skeletal muscle dysfunction. On the contrary, it is well known that exercise helps improve bone health. Therefore, the aim of this study was to investigate whether exercising in conjunction with a high phosphate (HP) diet could alter site specific mineralization of bone by comparing the jaw and femur in mice.

METHOD
Following IACUC approval, twelve C57BL6 male mice (10-weeks-old) were fed with a normal phosphate (NP) diet containing 0.9% inorganic phosphate (PI) for 20 weeks with and without mandatory wheel running exercise (n=5 for sedentary and n=3 for wheel running) and with high phosphate (HP) diets containing 2.3% Pi for 20 weeks with mandatory wheel running exercise (n=4). A mandible and femur were dissected from each animal and scanned using a micro-computed tomography (micro-CT) at 20-micron voxel size. Mandibular bone was isolated after digitally removing teeth in the micro-CT image. Bone Volume (BV) was obtained by counting bone voxels segmented from non-bone voxels. A tissue mineral content was computed by the sum of gray values in each bone voxel. An analysis of variance was used to compare measures between the mouse groups with a significance of p<0.05.

RESULTS
For the femur, the NP exercise group had significantly higher BV and tissue mineral content (TMC) than the other groups (p<0.02) while those values are comparable between the HP exercise and NP sedentary groups (p>0.08). For the mandible, the BV of the HP exercise group had a significantly smaller value than that of the NP sedentary group (p=0.009) and moderately smaller than that of NP exercise group (p=0.06).

CONCLUSION
These findings indicate that exercising enhances bone loss due to HP diet for orthopedic bone but has less of an effect on oral bone.
How Does Cognitive Impairment Affect Dental Decision-Making in Older Adults?

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OBJECTIVES
Decision-making is often compromised in older adults with cognitive impairments. Yet, how cognitive impairment affects dental decision-making remains unclear. We sought to describe dental decision-making capacity in older adults with varying degrees of cognitive dysfunction.

METHODS
Sixty-five participants, including 14 healthy comparison participants and 51 with documented cognitive impairment, were categorized into healthy comparison, mild cognitive impairment (MCI), mild dementia, moderate dementia and severe dementia. A hypothetical dental problem along with three treatment options were presented. Participants were first asked to identify the problem, related treatment options and the pros and cons of each option. They were then asked to choose a treatment using the hypothetical given funds. Visual and verbal cues were provided if participants failed to complete the task independently. Participants were scored based on their performances. Data were analyzed using the Kruskal-Wallis test and Holm method for multiple comparisons and a linear regression model for the multivariable analysis.

RESULTS
Among those with cognitive impairment, 96% exhibited deficits in decision-making capacity. Sixty percent of those with MCI and 70% of participants with mild dementia were not able to explain pros and cons of the treatment choices, significantly higher than that in the healthy comparisons (10%). The decision-making capacity significantly differed across groups (p<0.001). Compared to the healthy comparisons, decision-making capacity decreased 18%, 33%, 71% and 86% in the MCI, mild dementia, moderate dementia and severe dementia groups, respectively.

CONCLUSION
Dental-related decision-making deficits were highly prevalent in older adults with cognitive impairment, including individuals with MCI who are in the earliest phase of cognitive decline.
Impact of Ex Vivo Saliva Conditions on Streptococcus Oralis Fitness

Allen Choi and Justin R. Kaspar

OBJECTIVES
Oral streptococci encompass both pathogenic and health-related species involved in supragingival biofilm formation. Cariogenic strains cause dental caries by creating acidic conditions that break down enamel. Commensal strains antagonize these species with a model organism being Streptococcus oralis, an early colonizer abundant in the oral cavity. Lab-based growth media (TYG and CDM) are common for oral microbiology research; however, a knowledge gap exists regarding the effects of saliva-supplemented media on S. oralis fitness. This study compares S. oralis growth and transcriptional changes in lab-based media and media with human saliva to assess saliva’s effects on its behaviors.

METHODS
S. oralis growth was measured in a Bioscreen C over 24 h in either TYG or CDM and compared to the respective water-diluted and saliva-supplemented lab media. S. oralis gene expression between growth conditions was measured by RNA-Seq.

RESULTS
S. oralis exhibited a significant increase in growth in saliva-supplemented medias, with CDM showing a strong binary growth phenotype (abundant growth in saliva conditions and no growth in the absence of saliva). RNA-Seq indicated 148 upregulated and 58 downregulated genes in saliva, with ABC transporters, transcriptional regulators, glycosyl hydrolases, and genes involved in de novo purine and tryptophan biosynthesis among the most significantly upregulated genes.

CONCLUSION
This study correlates the presence of saliva in growth media with an increase in S. oralis growth and identifies genes upregulated within saliva. The next step for this project involves conducting transposon mutant sequencing to identify essential genes for S. oralis fitness in saliva. This approach is justified by the binary growth pattern of S. oralis in the presence and absence of saliva. As S. oralis serves as a model commensal organism, determining genes vital in saliva would allow for comparisons with other oral commensal species and further investigations into S. oralis gene expression in coculture.
Effects of 17-alpha Estradiol on Tooth Composition in HET3 Mice

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OBJECTIVES
Estrogen has been studied for its potential to extend longevity and reduce bone degeneration with age. The 17-alpha estradiol (17αE2) form of estrogen has been found to extend the lifespan of male UM-HET3 mice, a newly developed four-strain cross-bred mouse model preferred by the National Institute on Aging for lifespan and healthspan studies. Investigations into organ dynamics, including in teeth, were not performed in the initial reports. We hypothesized that craniofacial bone and tooth volume and density would be altered with 17αE2 administration and performed analyses to investigate these tissues.

METHODS
Male UM-HET3 mice were aged to 21, 60, and 105 weeks +/- 17αE2 in their diet for 19 weeks. Tissue samples were analyzed using micro-computed tomography (micro-CT) at 10 μm resolution to quantify the volume and density of mineralized tissues in the mandible including and surrounding the molars. Two-way ANOVA statistics were performed with an alpha value of 0.05 to determine measurement significance.

RESULTS
Compared to their age-matched counterparts, alveolar bone density decreased and dentin increased with age. In the middle-aged mice, dentin density increased with the addition of 17αE2. Cementum density increased with 17αE2 administration in the old mice compared to untreated old mice. No significant differences in volume of any hard tissues were found.

CONCLUSION
Our results suggest that 17αE2 affects the density of mineralized tissues in an ageand cell-dependent manner. 17αE2 administration could therefore be an attractive longevity treatment while also enhancing the structural integrity of craniofacial structures during the aging process. Histology of craniofacial samples and mechanical tests on long bones are currently underway. Future studies are scheduled to examine the effects of 17-beta estradiol, the dominant and feminizing form of estrogen, on male and female skeletal tissue with aging.
Peri-implant health- A Retrospective Study to Establish Risk Assessment Tools

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OBJECTIVES
Assessment tools to determine the risk of peri-implant tissue breakdown are in the development phase. A narrative review on 23 commonly cited criteria was previously completed: Each criterion was grouped as high, medium, or low risk based on their co-existence with peri-implant diseases. The current study aims to retrospectively evaluate patients with implant supported dental restorations in relation to this established risk assessment tool.

METHODS
AxiUm e-chart system is used to locate implant patients treated within Advanced Training Programs in Periodontics and Prosthodontics (IRB protocol #2023H0265). Charts that have 2 consecutive years of follow-up and full mouth periodontal/peri-implant charting are included. Records are evaluated for peri-implant tissue health (biological complications) and implant supported restoration failure (mechanical complications). The possible association between these complications and local periodontal/dental problems and systemic health problems/medications are explored. Preliminary data analysis is conducted by using descriptive statistics.

RESULTS
42 charts reviewed and 13 charts (8 male, age 62 ±9 yrs, 19 implants, mean 4.2 ±2 yrs in function) were included for preliminary data analysis. All implants were bone level with modified surface characteristics, restored as fixed restorations with 89% being single crowns. 16% (3 implants) were cemented. 47% (9 implants) were in maxilla and 58% (11 implants) were placed at a previously grafted site. 50% of sites had history of endodontic treatment (18% with previous periapical lesion). Biological complications were reported in 26.3% implants (5.2% and 21.1% diagnosed as peri-implant mucositis and peri-implantitis, respectively). The common mechanical complication was crown loosening (5.2%). 31% and 31% of patients had a history of periodontitis and smoking, respectively. 7.6% were diabetic. 15% of patients were on SNRI medication and 31% of patients were taking hyperlipidemia medication. Data collection and analysis are ongoing.

CONCLUSION
Local factors (e.g. previous endodontic treatment and history of bone grafting) may have higher risk impact on peri-implant tissue breakdown compared to systemic diseases that are controlled with medications.
Tissue-Nonspecific Alkaline Phosphatase Enhances Alveolar Bone Healing in Mice

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OBJECTIVES
Tissue-nonspecific alkaline phosphatase (TNAP) is an enzyme that plays a vital role in mineralization process, in part by inactivating inorganic pyrophosphate, a potent mineralization inhibitor. Functional ablation of TNAP (Gene: ALPL) contributes to hypophosphatasia, an inherited mineralization disorder featuring dentoalveolar mineralization defects and premature tooth loss. In mice, Alpl/TNAP is increased during alveolar bone healing and genetic ablation of Alpl/TNAP hampers proper healing, suggesting that TNAP might be a significant player in alveolar bone healing process. We hypothesized that the delivery of exogenous TNAP would improve alveolar bone healing.

METHODS
Wild-type mice at 7 weeks underwent bilateral maxillary first molar extraction. Collagen gel +/- TNAP (20 mg in 200 ul collagen I) (n=3-7/group) was immediately placed into tooth sockets. The TNAP used was asfotase alfa, an FDA-approved recombinant TNAP engineered to target and bind to mineralized tissues via a deca-aspartate tail. Mice were euthanized 21 days after the procedure. Maxillae were collected for micro-computed tomography (micro-CT), histology, and immunohistochemistry (IHC) for bone markers, TNAP, bone sialoprotein (BSP) and osteopontin (OPN).

RESULTS
Micro-CT revealed mice receiving collagen + TNAP had significantly increased alveolar bone bone volume fraction (BV/TV) of 20% compared to control mice receiving only collagen. No differences in bone mineral density (BMD) or tissue mineral density (TMD) were found. Masson’s trichrome stain confirmed increased bone healing in the TNAP-treated group compared to control. IHC showed normal bone distribution of TNAP, BSP, and OPN in healing bone in both experimental groups.

CONCLUSION
This study supports the beneficial effects of TNAP on alveolar bone healing in mice. Additional research is necessary to test dose-response, time course, and additional outcomes of alveolar bone healing. Additional preclinical models will be necessary prior to human clinical studies.
Gradual Release of Responsibility for an Objective Structured Clinical Examination

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OBJECTIVES
The COVID-19 related pause for live synchronous instruction highlighted the utility of technology-based learning methodologies in dental curriculums. Ensuring those methodologies are evidence-based and promote critical thinking challenged dental educators. We developed three training modules to test whether technology-based methodology improved pass rates on an Objective Structured Clinical Examination (OSCE) in pediatric dentistry.

METHODS
Asynchronous online modules were created using a modified gradual release of responsibility framework. These modules addressed three topics that had historically demonstrated higher failure rates on the fourth year OSCE: local anesthesia calculation, pulpal diagnosis in primary teeth, and emergency treatment of dental trauma. Pass rates were compared to 5-year historic controls with chi-square tests of independence. Students completed a 10-item pre- and post-module completion Likert style self-efficacy questionnaire, and the results were compared using Wilcoxon matched-pairs signed-rank tests.

RESULTS
First time pass rates for the test group (n =117) were significantly improved compared to historic controls for pulpal diagnosis in primary teeth (p=0.01), emergency treatment of dental trauma (p=0.04), and overall OSCE performance (p=0.04). The only topic to not demonstrate a statistically significant improvement in first time pass rate was local anesthesia calculation (p=0.28). Student self-efficacy significantly improved for all 10 items (p<0.001 for all items).

CONCLUSION
Utilizing asynchronous module-based learning with a modified general release of responsibility methodology improved student scores on a pediatric dentistry OSCE. This methodology holds promise in continuing to develop self-directed and engaged learners in dental education settings.
Enamel and Dentin Defects from Dentinogenesis Imperfecta in Secondary Dentition

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OBJECTIVES
Dentinogenesis imperfecta (DI) and dentin dysplasia (DD) arise from DSPP mutations. Affected individuals exhibit a spectrum of mild to severe disorders of dentin organization and mineralization. We previously identified a family with a DD/DI presentation in the young male proband, his older sister, and their mother. The proband exhibited the most severe phenotype of the family in his primary dentition, consistent with DI type III. His primary teeth displayed thin dentin, widened pulp chambers, abnormal or absent dentinal tubules, and disorganized and trapped odontoblasts. Unusually, he also had dramatically reduced enamel thickness and density. Severity of defects in DD/DI can vary between primary and secondary teeth. We aimed to determine if dentin and enamel defects were recapitulated in the secondary dentition of the proband.

METHODS
The proband underwent extraction of several secondary teeth due to susceptibility to pulp necrosis and abscesses. Extracted secondary teeth of the male proband (n=7) and healthy controls (n=6) were analyzed by high-resolution micro-computed tomography (micro-CT) and histology. Teeth underwent rapidly decalcification and were paraffin processed for histology.

RESULTS
Micro-CT revealed that the proband's secondary teeth had thin dentin and severely defective enamel that was barely visible. Enamel thickness was reduced 95% and enamel density was reduced more than 50% in DI vs. control teeth (both p<0.0001). Dentin thickness was reduced about 70% in DI vs. control teeth (p<0.0001), though dentin density was not diminished. Dentin matrix organization was severely disrupted in DI teeth compared to controls.

CONCLUSION
This family presents a combination of dentin and enamel phenotypes that is unusual for DD/DI. Severity of defects did not appear to diminish in secondary vs. primary dentition and several teeth required extraction. Additional studies are required to identify mechanisms underlying enamel and dentin defects.
Validation of Amelogenin-iCre Using a Double Reporter Mouse

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OBJECTIVES
Gene editing using the Cre-lox recombination approach in mouse models allows for tissue-specific gene deletion in the body. Although effective, the Cre-lox system has certain limitations such as undesirable expression, inefficient recombination, and perinatal lethality due to Cre toxicity. Few studies have utilized Cre-driver mouse lines specific for ameloblasts. The aim of this study is to verify the specificity of an enamel organ specific Cre-driver mouse line that expresses improved Cre (iCre) recombinase driven by the amelogenin promoter (Amelx-iCre).

METHODS
ROSA26mT/mG, a double reporter fluorescent mouse line, was used to track Cre-recombinase activity and its expression. The Amelx-iCre;mTmG were developed by crossing Amelx-iCre with ROSA26mT/mG floxed mice. Following euthanasia, organs were isolated from adult Amelx-iCre;mTmG mice, rinsed in PBS and imaged with a CCD camera mounted on a fluorescence microscope. Total DNA was extracted and purified from the individual tissues. Polymerase chain reaction (PCR) was performed using a primer pair to detect Cre-mediated recombination. The amplified PCR products were analyzed by agarose gel electrophoresis. Additionally, mandibles from five- and twelve-day post-natal pups and tissues from adult mice were harvested, embedded in optimal cutting temperature (OCT), and cryosectioned. Sections were mounted on slides, counterstained with DAPI and visualized under a fluorescent microscope.

RESULTS
Tissues in the mTmG floxed mice without Amelx mediated Cre expression display red fluorescence. In the presence of Cre-recombinase, the tissue fluoresces green due to removal of sequence encoding red fluorescence, which is replaced by green fluorescent protein (GFP) sequence. Positive GFP expression was solely observed in the enamel organ. Additionally, PCR analysis revealed amplification of the recombined mTmG sequence solely in the enamel organ.

CONCLUSION
The Amelx-iCre;mTmG reporter mice effectively demonstrated specificity of Cre recombinase activity in the enamel organ. Our results validate the Amelx-iCre mouse line as a powerful tool for future enamel research.
Efficacy of Oral Healthcare Antimicrobials on Streptococcus mutans Clinical Isolates

Nicole A. Fleming and Justin R. Kaspar

OBJECTIVES

Streptococcus mutans has been shown to be a main contributor to dental caries. The biofilm that S. mutans produces is thought to increase the bacteria’s tolerance to antimicrobials, however, the precise sensitivity of S. mutans to different antimicrobials remains undefined. In this study, we tested twenty different clinical isolates of S. mutans with varying concentrations of the oral antimicrobial chlorohexidine (CHX) before and after biofilm formation.

METHODS

Biomass formation of twenty different clinical isolates of S. mutans were inoculated with increasing concentrations of chlorhexidine and quantified using a crystal violet assay. Next, 24 h biofilms of eight selected isolates were presented with increasing concentrations of chlorhexidine for 30 s before a stain detecting cell death (SYTOX Green) was applied along with a total cell stain (Hoechst). Fluorescent microscopy was then utilized to analyze both the amount and spatial distribution of dead cells within biofilm structures.

RESULTS

The crystal violet assay showed that the twenty different isolates had varying abilities to form biofilms in the presence of chlorhexidine with most isolates not being able to form biofilms in concentrations greater than or equal to 0.75 μg/mL CHX. The fluorescent microscopy showed that there was no significant effect of the 50 μg/mL CHX on cell death compared to the control (0 μg/mL CHX). However, there was varying degrees of changes in cell death with the 500 μg/mL CHX condition.

CONCLUSION

Data obtained from this study present evidence that clinical isolates of S. mutans are more sensitive to chlorhexidine prior to biofilm formation and that different clinical isolates have varying degrees of sensitivity. However, there appears to be no association between the amount of biofilm formation and S. mutans’ tolerance to antimicrobials. By studying other antimicrobials, such as cetylpyridinium chloride (CPC), we can assess which antimicrobials are most effective and explore if combinations of multiple antimicrobials are advantageous.
Material Strength Variation in 3D Printing Build Directions

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OBJECTIVES
Fused Deposition Modeling (FDM) 3D printing is widely used in dentistry to create precise models, surgical guides, and mouthguards. This additive manufacturing technique involves layering thermoplastic materials to construct detailed dental structures. FDM technology ensures accurate anatomical representations for dental models, aids in the fabrication of precise surgical guides for procedures and produces customized mouthguards with optimal fit and functionality. However, the bonding junction between 3D printed layers may weaken under tension and compression. This study aims to assess the impact strength of vertically and horizontally 3D-printed polyolefin samples using the IZOD ASTM D256 impact test. The investigation focuses on potential variations in material strength based on the orientation of the printed layers, recognizing the critical role of bonding integrity in withstanding mechanical forces.

METHODS
Two study groups were created, vertically and horizontally oriented 3D printed builds. Ten samples of each 3D print direction were done using polyolefin FDM following a modified version of ASTM D256. Impact absorption testing was completed at The Ohio State University CDME employing a benchtop Izod impact striker machine. Statistical analysis, including mean, median, T-Test and standard deviation were completed.

RESULTS
Polyolefin samples that were notched horizontally, perpendicular to the build direction, demonstrated significantly higher impact strength (p = 0.035) than samples that were notched vertically, parallel to the build direction. Additionally, laminar separation was observed on all 3D-printed samples test specimens and is being quantified.

CONCLUSION
This study evaluated the impact strength of vertically and horizontally 3D-printed polyolefin samples using the IZOD ASTM D256 test. Horizontal notched samples exhibited significantly higher impact strength (p = 0.035) compared to their vertically notched counterparts. The study underscores the importance of print orientation in determining material strength and highlights potential considerations for optimizing 3D printing processes in dentistry.
Testing Cementocyte Functions in Cellular Cementum Formation Using Two Challenge Models

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OBJECTIVES
Cementocytes reside in the cellular cementum of the apical tooth root and resemble bone osteocytes in their morphology, lacunocanalicular network, and expression of key markers. However, it is unclear if cementocytes have a role in regulating cellular cementum similar to that of osteocytes in controlling bone remodeling. We used two mouse models to promote cellular cementum formation and assess the role of cementocytes in cellular cementogenesis. The Sost⁻/⁻ mouse lacks sclerostin, a Wnt inhibitor, and these mice reportedly have increased bone and cellular cementum growth due to overactive Wnt signaling. The Dmp1Cre-iDTRfl/fl mouse sensitizes Dmp1-expressing cells, including osteocytes and cementocytes, to diphtheria toxin (DT), allowing selective ablation of cell populations. Both models were subjected to the challenge of unopposed first molar super-eruption, which promotes increased cellular cementum production.

METHODS
Maxillary first molars were bilaterally extracted from Sost⁻/⁻ and control mice at 7 weeks. Dmp1Cre-iDTRfl/fl and control mice were dosed with 1 μg/kg DT at 6 and 7 weeks and maxillary molars were bilaterally extracted at 7 weeks. Effects on cellular cementum accumulation in mandibular first molars were analyzed at 21 days post-procedure using micro-computed tomography and histology (n≥4/group).

RESULTS
In response to unopposed super-eruption, cellular cementum volume nearly doubled in control mouse molars but increased only 30% in Sost⁻/⁻ molars. Immunostaining for Axin2 and DKK1 indicated reduced Wnt activity in cementocytes vs. osteocytes of Sost⁻/⁻ mice. In the cementocyte ablation model, DT administration eliminated approximately 80% of cementocytes in Dmp1Cre-iDTRfl/fl mice, and this did not impair cellular cementum accumulation.

CONCLUSION
Based on two, challenge models, we found no evidence that cementocytes play a critical role in cellular cementum accumulation. Additional models may provide further insights, and the role of cementocytes in cementum resorption should be studied.
CBCT to Detect Decrease in Bone Density of Aged Women

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OBJECTIVES
As women age, trends exist of a decrease in bone mineral density. This is most often caused by the effects of menopause. If left untreated, patients with this disease as well as other diseases causing a decrease in bone mineral density (BMD) often experience pathologic fractures among other morbidities. Diagnosing osteoporosis has conventionally been conducted by assessing bone mineral density (BMD) of thoracic or lumbar spine using 2-dimensional imaging of dual energy X-ray absorptiometry (DXA). The objective of this study is to examine whether dental 3-dimensional cone beam computed tomography (CBCT) has to ability to assess BMD changes of the cervical vertebrae as an alternative diagnostic tool. Thus, aiding in the screening of patients on routine dental visits for decreases of BMD.

METHODS
Following IRB approval, 209 CBCT images were retrospectively obtained from 75 male and 134 female patients (20 to 85 years of age) on routine dental patients. The CBCT images were assigned for 3 age groups including 40-age group (20 to 49 years), 50-age group (50 to 59 years old), and 60-age group (older than 60 years old). The odontoid process of the second cervical vertebral body (C2) was digitally isolated by removing posterior and lateral processes. A gray value, which is proportional to BMD, was assessed. Mean gray values of C2 were computed and tested using analysis of variance followed by Tukey HSD post hoc test was performed to compare age group of male and female groups with significance of p<0.05.

RESULTS
The female group had significantly lower mean and Low5 values of C2 for the 60-year group than for the 40 years group (p<0.008) while all other values were not significantly different between age groups in male and female (p>0.103).

CONCLUSION
As previously mentioned, menopause is assumed to be the likely cause of the major trend of a decrease in bone mineral density of the 60-year-old female group. The successful appreciation of this trend through our samples confirms that CBCT can indeed act as a diagnostic tool for decreasing levels of BMD.
Examination of Dental Hygiene Program Websites for Diverse Representation

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As the population in the United States grows, the ethnic and racial minority populations continue to grow as well. Despite the continuous growth of ethnic and minority populations, minority populations are still under-represented in healthcare professions. Dental Hygiene is experiencing a lack of diversity among applicants and in the field with 96% of dental hygienists being women and 91% being White. Dental hygiene programs often use their websites to promote and attract students to their programs. This study examines current dental hygiene program websites to determine how they represent diversity. Images from the ‘home’ and ‘about’ pages of accredited dental hygiene programs were archived. The people in each image were coded related to role, race, age, and gender. Descriptive statistics were used to examine the content related to diversity. Two investigators coded the data. If the codes did not match a third investigator determined the code. 2087 people were identified in the images and coded from the websites. Most were young adults (64.4%), White (72.4%), female (86.2%), and students (67.7%). While most people were coded as White, students were 70% White, patients were 72.5% White, and staff 56.8% White. Staff had the highest number of Black representations at 24.3%, and instructors the lowest at 2.3%. Dental hygiene websites lack a diverse representation of students on their websites. Demonstrating a diverse student population on a program website may be one way to recruit a diverse applicant pool, particularly given recent court decisions related to using race in admissions decisions.
Tissue Mineral Density Distribution in Jawbone of Aged Ovariectomized Rat

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OBJECTIVES
Osteoporosis is a systemic bone disease that progressively reduces bone mineral density with aging. Aged women have a high risk of osteoporosis due to postmenopausal estrogen deficiency. Most of clinical and preclinical animal models have been investigated for orthopedic bone but studies for jawbone have been relatively limited. Thus, the objective of this study was to investigate whether estrogen deficiency in aged ovariectomized (OVX) rats more aggravates loss of bone mineral than young rats.

METHODS
Following approval from the IACUC, 20 female Sprague Dawley rats were acquired, consisting of 10 sham (3 months following sham operation at 6 months old), 5 OVX (3 months following OVX operation at 6 months old), and 5 Aged OVX (2 months following OVX surgery at 12 months old) rats. Mandibles were dissected to be scanned by micro-computed tomography. After digitally removal of teeth, the tissue mineral density (TMD) was obtained for each bone voxels of the whole bone (WB), alveolar bone (AB), and basal cortical bone (CB). Histograms for TMD were generated to measure mean, standard deviation (SD), fifth percentile low (Low ), and high (High ) TMD values for each bone region. An analysis of variance followed by a Tukey HSD post hoc test was used to compare the sham, OVX, and aged OVX groups. Significance was set at p<0.05.

RESULTS
The aged OVX group had significantly higher values of Mean and High than both OVX and Sham groups for WB, AB, and CB (p<0.03) except for the mean value for WB of Sham group (p=0.08). All other TMD parameters and BV were not significantly different between groups (p>0.07).

CONCLUSION
The TMD parameters were not decreased by OVX with aging. These findings suggest that the jawbone may have different mechanisms for controlling bone mineral than other bones in the body.
Alveolar Bone and Cervical Vertebral Density Decrease in Aging Women

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OBJECTIVES
Bone mineral density (BMD) of vertebrae in postmenopausal women were used to evaluate a higher risk of developing osteoporosis. The resulting low BMD may also contribute to bone loss around teeth, leading to periodontal disease and tooth loss. Cone beam computed tomography (CBCT) is widely used as an X-ray based diagnostic tool for oral bone in dentistry. As the CBCT imaging also includes cervical vertebra, it may be alternatively used to assess BMD. Thus, the objective of this study was to examine whether aging changes BMD of cervical vertebra (C3) and oral bone surround teeth using CBCT images of patients.

METHODS
Following IRB approval, CBCT images were retrospectively obtained from 64 patients. Twenty-two males (22 to 69 years) and 42 females (20 to 69 years) were assigned to three age groups, including 40-age group (20 to 49 years), 50-age group (50 to 59 years), and 60-age group (older than 60 years). Alveolar bone (AB) surrounding premolar tooth roots, and cervical vertebra (C3) were digitally isolated. Volume and mean CT attenuation values (gray values) were measured. The mean gray value is proportional to BMD. Analysis of variance followed by Tukey post hoc test and Pearson’s correlation were performed to examine the effect of age on BMD with p<0.05.

RESULTS
The C3 of the 60-age female group had a significantly lower mean gray value than that of the 40-age female group (p=0.037). All other values were not significantly different between age groups in males and females (p>0.213). The mean gray value of C3 significantly decreases with age more than that of AB in females (r=-0.47, p=0.002 and r=-0.369, p=0.016).

CONCLUSION
The decrease in BMD of C3 and AB in aging women suggests that the systemic change of BMD may also put aging women at risk for periodontal disease and tooth loss.
Gender Dependent Differences of Cervical Vertebral Bone

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OBJECTIVES
A dental cone beam computed tomography (CBCT) has been widely used to provide 3D image of dental, oral, and craniofacial structure. In addition, the CBCT can scan cervical vertebrae. As an X-ray based tool, the CBCT can be used to assess bone mineral density (BMD). Thus, the objective of this study was to test whether the CBCT based measures for morphology and bone mineral density (BMD) of C2 and C3 are different by gender and age.

METHODS
Following IRB approval, CBCT images of 49 males and 103 females were retrospectively collected. The CBCT images were assigned for 3 age groups including 40-age group (20 to 49 years old, 9 males and 41 females), 50-age group (50 to 59 years old, 17 males and 29 females), and 60-age group (older than 60 years old, 23 males and 33 females). The second and third cervical vertebral (C2 and C3) bodies were digitally isolated. The number of voxels in C2 and C3 was counted to compute their volumes. A gray value that is proportional to BMD, was obtained for each voxel. The volume and mean gray values of C2 and C3 were compared between the male and female age groups with significance of \(p<0.05\).

RESULTS
The female had significantly smaller volume of C2 and C3 than the male for each age group \((p<0.003)\). The mean gray value of C2 was not significantly different between male and female for each age group \((p>0.0771)\) while that of C3 was significantly higher for the female than the male \((p<0.009)\) except 60 years group \((p=0.648)\).

CONCLUSION
The C3 had more gender dependent differences showing the smaller size but higher BMD for the female group than the male group. The BMD of C3 decreases in aged women that may result from postmenopausal osteoporosis.
Socket Preservation Clinical Outcomes: Comparison of two Surgical Approaches-
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OBJECTIVES
Socket preservation (SP) is a bone regeneration procedure indicated immediately following tooth extraction to preserve existing alveolar ridge height and to control alveolar ridge width resorption. A collagen plug (CP) and/or barrier membrane (BM) is generally used to stabilize bone graft. To our knowledge the indications for these two types of biomaterials are not well-established. The purpose of this study is to evaluate early clinical outcomes following SP performed by using CP or BM as a sealing material.

METHODS
Patients scheduled for single extraction and socket preservation at a tooth bounded site (IRB #2022H0277) for future implant placement procedure were recruited. Ridge width and soft tissue phenotype were determined prior to extraction and during observation period through clinical examination and digital impressions. Allograft together with CP or BM was used for SP, based on standard site specific indications and, stabilized with resorbable sutures. Follow-up intervals were 10-14 days, 4-6 weeks, and 4-6 months. Well-established clinical indices were used to evaluate soft tissue wound healing. At the time of implant placement, bone quality was determined by interviewing the surgeon and by measuring implant stability through resonance frequency analysis (RFA).

RESULTS
16 subjects completed surgical treatment (12 male; mean 62 yrs ± 11; 6 past smokers; 6 with history of periodontal disease; 14 posterior sites; 9 CP, 7 BM). Mean pre- and post-surgery ridge width was 12±2mm and 12.4±3mm for CP and 12±1mm and 13±2mm for BM, respectively (p>0.05). For CP and BM, 56% (5 subjects) and 57% (4 subjects) sites presented complete clinical wound closure by 4-6 weeks, respectively (p>0.05). Based on preliminary data analysis, changes in ridge width at 4-6 months were negligible for both groups. Similarly, healing indices, tissue phenotype, bone quality and RFA were not differentially affected by treatment modalities. Recruitment and data analysis are ongoing.

CONCLUSION
Use of CP provides similar clinical results to BM when used as a sealing material following socket preservation procedures.
Factors Associated with Orthodontic Patient In-treatment Compliance and Final Outcome

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OBJECTIVES
A clearer understanding of factors associated with patient's compliance during orthodontic treatment and the quality of final treatment outcome is important for both clinicians and patients. The project was aimed at assessing the relationships among several pretreatment factors and final orthodontic treatment outcome.

METHODS
Following predesigned inclusion and exclusion criteria, orthodontic records of 309 patients treated at The Ohio State University orthodontic clinic were used. Data of 7 pretreatment factors (age, sex, race, socioeconomic status, oral-hygiene, initial PAR score, severity of orthodontic problem based on initial PAR) were collected. Based on designed criteria, in-treatment compliance was classified into three levels by two independent raters though reviewing treatment notes. Treatment outcome was also graded into three levels by evaluating absolute final PAR score and relative PAR score reduction. Reliability of compliance, outcome classification and PAR scoring was tested by Cohen's Kappa and intra-class correlation (ICC) tests, respectively. Ordinal logistic regression models were employed to test factors predictive of in-treatment compliance and factors predictive of final outcome.

RESULTS
Intra-rater reliability of PAR scoring was over 0.9 (ICC) and inter-rater reliability of compliance and outcome classifications was over 0.7 (Kappa). Ordinal logistic regression demonstrated that declining in-treatment compliance was significantly correlated with worsening of oral-hygiene status (p=0.026, odds ratio 1.50) and increase of initial PAR score (p<0.001, odds ratio 1.05). Declining in in-treatment compliance was significantly correlated with worsening of treatment outcome, in both absolute final PAR (p=0.016, odds ratio 1.47) and relative PAR score reduction (p=0.032, odds ratio 1.46).

CONCLUSION
Poor in-treatment compliance may lead to lowered quality of treatment outcome while poor initial oral hygiene may be a predictor for inferior in-treatment compliance.
Bone Mineral Density of Mandibular Condyle Changes during Orthodontic Treatment

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OBJECTIVES
Clinical studies have shown orthodontic treatment can alter the morphology and relationship between the mandibular condyle and temporomandibular fossa. Both bone modeling and remodeling are involved in the affected morphological changes. As such, we hypothesize that the radiographic bone mineral density (BMD) distribution and condylar morphology is also modified by the bone modeling and remodeling. The aim of this study was to examine whether clinical 3D cone beam computed tomography (CBCT) can detect the changes of bone mineral density (BMD) distribution of the mandibular condyle during orthodontic treatment.

METHODS
Following IRB approval, CBCT images of 43 patients (19 males and 24 females, mean age of 14.36±1.50 years old, range of 11.5 to 17.4 years) were randomly collected using retrospective records before and immediately after comprehensive orthodontic treatment with full fixed appliances (20.05±4.18 months of treatment duration). Right and left condyles were digitally isolated parallel to the occlusal plane with the height of 7 mm from the condyle top. A histogram of the CBCT attenuation value (gray value), which is equivalent to BMD, was analyzed for each condyle at pre- and post-orthodontic treatment. Gray values were determined at the mean, lower and upper 5th percentile values of each histogram at pre- and post-treatment and they were compared via a paired t-test. Significance was set at p<0.05.

RESULTS
No radiographic sign of TMJ disorder was observed before and after treatment. Currently examination of 11 paired CBCT images were analyzed. The results indicate that the mean and lower 5th percentile values of the gray value histograms (2061.73±33.27 and 1923.75±27.58) significantly increased after treatment (2112.22±29.12 and 1982.17±49.51, p<0.003).

CONCLUSION
This finding suggests that occlusal changes due to orthodontic treatment may have an effect on mandibular condyle. More analysis is underway for the rest of CBCT images.
Utilizing Microscopy to Analyze and Interpret Oral Streptococci Interspecies Interactions
Sarah Klingerman and Justin R. Kaspar

OBJECTIVES
Biofilms within the oral cavity can consist of multiple different bacterial species and strains, and its formation is impacted by environmental factors such as saliva. In particular, mutans group streptococci (Streptococcus mutans and Streptococcus sobrinus) are important to investigate as they produce acidic byproducts as a result of fermentation from carbohydrates present in the diet. These acidic byproducts are meaningful to examine as they are directly associated with demineralization of teeth. To investigate individual isolates of these species and environmental impact(s), we aimed to utilize microscopy to observe and quantify biofilm formation with different growth mediums, such as artificial saliva.

METHODS
Biofilms of various Streptococcus isolates, specifically Streptococcus sobrinus and Streptococcus mutans, were grown in different environments for 24 hours and then stained for imaging. We utilized a Hoechst total cell stain (DAPI) to visualize cells within the biofilm, RFP to detect the eDNA using DNA-specific antibodies that were fluorescently labeled, and CY5 to detect glucans using Alexa Fluor 647-labeled dextran. Biofilms were captured via widefield microscopy imaging microscope and each fluorescent channel was quantified for biomass then analyzed between isolates and conditions.

RESULTS
Individual isolates of S. sobrinus displayed variations in biofilm matrix production (eDNA and glucans), as well as how the matrix was spatially organized. We also determined that compared to the control, there was significantly less biomass and number of microcolonies of cells when grown in a medium that contained artificial saliva compared to human saliva, suggesting artificial saliva does not fully replicate biofilm formation phenotypes.

CONCLUSION
Our established microscopy protocols were able to successfully visualize and evaluate differences in single isolates of different species as well as within different environments. These techniques provide insight into interspecies interactions in the oral microbiome and potential for further understanding of the development of oral disease formation.
The Oral Microbiome in Pediatric Hematopoietic Cell Transplant Recipients

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OBJECTIVES
Oral mucositis (OM) is a toxic side effect during hematopoietic cell transplant (HCT) and a risk factor for bloodstream infections (BSI). Although oral microbial dysbiosis is suggested to be associated with OM and oral bacterial species are implicated in BSI, majority of this research is limited to adults. We evaluated the oral health of pediatric HCT recipients and characterized their oral microbiome during OM and BSI development.

METHODS
Ten subjects were followed longitudinally during HCT therapy. Oral indices (gingivitis, plaque, tongue coating) and mucositis grades were recorded. Site-specific oral samples (plaque, mucosa, tongue) and BSI-positive blood samples were collected for 16S rRNA sequencing. Beta-diversity was measured using Bray-Curtis dissimilarity for sampling sites and PERMANOVA was used to examine bacterial community composition change as OM developed. Amplicon sequence variants generated through DADA2 allowed high resolution identification and tracking of organisms between oral niches and blood.

RESULTS
Progression of OM and changes in oral indices was observed as subjects underwent HCT. Distinct microbial communities colonized different oral sites ($P=0.001$) and site-specific microbial communities changed based on OM grade (plaque $P=0.023$, buccal mucosa $P=0.006$, tongue $P=0.041$). Polymicrobial profiles containing microbial species common to the oral cavity were identified in the bloodstream of subjects with BSI.

CONCLUSION
Distinct microbial signatures were observed in plaque, mucosa and tongue, and these communities shifted as OM developed. High resolution tracking linked BSI to an oral source. These data provide the foundation for future mechanistic studies and development of preventive therapies for bloodstream invasive oral microbes.
Electronic Nicotine Delivery System Effects on Murine Mandible Development

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OBJECTIVES
The use of vaping and electronic nicotine delivery systems (ENDs) have increased in recent years. Lifetime global vaping prevalence is approximately 23% (1). Further, one in 20 women report vaping during pregnancy, which raises concerns as the use of nicotine during pregnancy has been found to increase birth defects (2). The objective of this study is to determine how ENDs exposure in utero affects mandible development.

METHODS
Wild type C57BL6 pregnant mouse dams were used to produce litters that were exposed in utero (E0.5-term) to free air (control), a 30:70 PG:VG carrier ratio with no nicotine present, or to ENDS (30/70 PG/VG volume ratio, 20mg/ml concentration amount of nicotine), respectively. MicroCT images were obtained on perinate skulls at post-natal day 14 (PN14) using a SkyScan 1176 (Bruker Kartuizerseg 3B, 2550 Kontich, Belgium) scanner. Scans were collected on 101 perinates. Murine skull MicroCT images were further subject to cephalometric analysis using AnalyzePro software to assess changes in the lower jaw (Figure 1). Data was screened for normality and homogeneity of variance and a One-Way ANOVA or Kruskal Wallis analysis followed with Bonferonni post-hoc analyses.

RESULTS
For somatic development, weight was observed to be significantly different with the 30/70 carrier group observed to weigh less than the free air control (p=0.046), however all animals were found to be in normal range for age and sex for C57BL6 PN14 pups. For mandibular morphology there were significant differences found in angle process height, ramus height, total length, and middle body height where carrier control was most affected. Furthermore, the distribution of the angle process height bilateral discrepancy indicating asymmetry) was also found to be significant for that group.

CONCLUSION
Carrier 30:70 PG:VG exposure in utero influences mandible development in mice. Uniquely, the effects of the 30:70 PG:VG with nicotine on murine offspring were reduced compared to carrier only. This suggests that PG:VG mixtures used in ENDS delivery systems may negatively affect development. Future research will seek to extend these models to vary both PG/VG ratio formulation, nicotine concentrations, and other common ENDS components (acids and flavorants).
Changes in *S. mutans* Biofilm Formation During Growth in Human Saliva

**Huizhen Lim** and Justin R. Kaspar

**OBJECTIVES**
Streptococcus mutans is a known cariogenic microbe that widely affects oral health on a global scale. We have obtained twenty *S. mutans* isolates to determine if growth media variation and inclusion of human saliva alters biofilm formation patterns and spatial organization/structure. Previously, we have looked at a single strain of *S. mutans* in growth medium containing saliva and observed modifications in displayed biofilm phenotypes. We wanted to determine if this result would also occur for a diverse panel of twenty *S. mutans* clinical isolates.

**METHODS**
Monoculture growth of *S. mutans* isolates was examined through widefield microscopy using a 40x objective with four images taken per sample. Images were acquired using DAPI (Hoechst total cell stain), RFP (antibody labeled-eDNA) and CY5 (Alexa Fluor-labeled dextran) channels. Cultures were grown in TY-, TY-Saliva, and TY-Water (control) mixes for 24 hours prior to imaging. Biofilm data was extracted using the Gen 5 v3.1 software and measurements of biovolume and biomass were obtained and compared between conditions.

**RESULTS**
Through imaging the various *S. mutans* isolates, we found differing amounts of cell biomass between TY- and TY-Saliva. Additionally, we found varying amounts and distributions of extracellular matrix through variability in both glucans and eDNA. This result was further supported by significantly different biomass values across total cells, glucans, and eDNA.

**CONCLUSION**
We found significantly different growth profiles among the isolates when saliva was included. In addition, there were differences in cell biomass, eDNA, and glucans distributed across isolates and media types, which supports our hypothesis. The investigation demonstrates how *S. mutans* can have drastically different phenotypes based on the isolate as well as medium used. This study highlights changes in *S. mutans* based on the environmental conditions that can affect other clinical and laboratory studies.
Patient Non-Attendance at Orthodontic Appointments Before and After COVID Outbreak

Samantha Marks, Florence Foucher, William Johnston, Henry Fields, Ching-Chang Ko, Zongyang Sun

OBJECTIVES
Patient broken appointments (BAPs) can adversely affect patient care and education in graduate orthodontic clinics. This study investigated the impact of a number of patient/treatment factors, together with the outbreak of the COVID pandemic, on orthodontic patients’ BAPs.

METHODS
Following defined inclusion/exclusion criteria, treatment records from 1,729 patients who underwent active orthodontic treatment at The Ohio State University graduate orthodontic clinic from July 2017 to June 2019 (pre-COVID, n=912) and from September 2020 to August 2022 (post-COVID, n=817) were assessed. Overall BAP rate, urgent appointment rate, and BAP frequency were calculated and compared between the two periods. Data on patient/treatment factors including age, sex, race, socioeconomic status, guardianship, distance from clinic, financial account status, treatment duration before the first BAP (TD-1stBAP), total treatment duration, treatment appliance, and pre-/post-COVID period were collected. With BAP frequency as the dependent variable, analysis of covariance was performed to identify factors and their potential interactions that vary BAP frequency.

RESULTS
BAP rate was not different between pre-/post-COVID periods (t-test, p=0.282), but post-COVID urgent appointment rate was significantly higher than pre-COVID (t-test, p=0.003). Results of ANCOVA showed BAP frequency was significantly affected by the interactions of pre-/post-COVID period with several factors (race, p=0.008; guardianship, p=0.009; age, p=0.020 and TD-1st BAP, p<.0001), as well as affected by two factors individually (socioeconomic status, p=0.004; total treatment duration, p<0.0001).

CONCLUSION
The onset of the COVID pandemic has changed orthodontic patients’ appointment-keeping behavior in a graduate orthodontic setting through interacting with race, guardianship, age and treatment duration factors. In addition, regardless of COVID, socioeconomic status and total treatment duration can significantly affect patients’ BAPs as well.
Silver diamine fluoride represents 10% of caries-related treatment in claims

Beau D. Meyer, DDS, MPH; Donnie Clark, PhD

OBJECTIVES
Silver diamine fluoride (SDF) is an effective treatment for dental caries. Despite documented effectiveness, the widespread use of SDF in daily clinical practice is likely low in the context of other caries-related treatments. The objective of this study was to describe the SDF proportion of dental caries-related treatment among a Medicaid-enrolled pediatric population.

METHODS
This cross-sectional study from 2020-2022 used aggregate dental claims from Partners For Kids, a pediatric accountable care organization in western, central, and southern Ohio responsible for healthcare delivered to Medicaid-enrolled children. Children ages 0-18 years old with dental claims were included. County, procedure, and provider type (general versus pediatric dentist, identified using taxonomy codes) were recorded from claims. Two outcomes were reported: preventive dental visits (procedure codes: D1110, D1120, D1206, D1208), and dental caries-related treatment (procedure codes D1354, D2000-D2999, D7140). County-level dentist:population ratios were included for context. Analysis relied upon descriptive statistics and Pearson correlation.

RESULTS
Among 469,421 beneficiaries, 34% (n=161,274) had a preventive dental visit, and 30% (n=140,105) had a caries treatment visit. Among those with a caries treatment visit, 9.9% received SDF. Pediatric dentists billed 38% of all caries treatment claims and 26% of all SDF claims. One provider was responsible for 16% and one organization was responsible for 27% of SDF claims. County-level analysis showed wide variation in SDF use (range 1% to 58%). No significant correlations were noted between SDF use and procedural, provider, or county-level data.

CONCLUSION
Among a subset of Medicaid-enrolled children in Ohio, SDF utilization was low and highly variable. Both general and pediatric dentists were using SDF to treat dental caries in children. However, patterns of use likely cluster around particular practices. More research is needed to understand how evidence, policies, and guidelines for novel treatments are implemented at population levels.

ACKNOWLEDGEMENTS
The data used for this analysis were made available through a Data Use Agreement with Partners For Kids, a pediatric accountable care organization established by Nationwide Children's Hospital. The statements in this manuscript are solely the responsibility of the authors and do not necessarily represent the view of Partners For Kids or Nationwide Children's Hospital.
Exploring the Attitudes of Women Dental Students Regarding Becoming Oral and Maxillofacial Surgeons

Katelyn H. Conley, Courtney Jatana, Fernanda Schumacher, Wei-En Lu, Anika Moffitt

OBJECTIVES
While women represent half of the dental student population in the U.S., only 8% of practicing oral surgeons are women, making it the one of the worst female-represented specialties with orthopedic surgery at 15.4%. The aim of this study was to explore the attitudes of women dental students in their first (D1) and final (D4) years of dental school in regards to pursuing a career in Oral and Maxillofacial Surgery (OMS). Specifically, what are the perceived barriers, motivating factors, and how do these differ as students progress? Further, what are the commonalities for those who choose to pursue OMS?

METHODS
A Qualtrics survey was sent to each U.S. dental school for distribution to all D1 and D4 women. Exclusion criteria was no consent. Perceived barriers and motivating factors were answered using a sliding scale from 0 to 5 with 5 being most important. Items selected for rating were based on prior literature and a free response was provided after each question. For any comparisons between D1 and D4, data was analyzed using the Mann Whitney test and adjusted for multiple correction using Bonferroni method.

RESULTS
All responses were pooled to identify statistically significant barriers and motivating factors (n=338). Barriers of significance were time commitment (86.2%), family sacrifices during residency (75.2%), long work hours during residency (70.7%), and need to perform at top of class (64.6%). Significant motivating factors included financial security (82.1%), scope of field/interesting procedures (71.2%), respect (62%), and lifestyle after residency (51.4%). When comparing D1 and D4 responses, the only barrier of statistical difference was the need to perform at the top of the class, with D1’s rating it more important (4.14/5) and D4’s rating 3.51/5 (adjusted p-value = 0.02 < 0.05). The motivation of “lifestyle after residency” was also significantly different with D1’s rating 3.81/5 and D4’s rating 3.26/5 (adjusted p-value = 0.03 < 0.05). There were only nine D4 women who applied to OMS residency, so their responses did not have statistical significance.

CONCLUSION
In conclusion, the perceived barriers of significance (in order of importance) were time commitment, family sacrifices during residency, long work hours during residency, and need to perform at top of class (academic stress). Significant motivating factors (in order of importance) included financial security, scope of field/interesting procedures, respect, and lifestyle after residency. When comparing D1 and D4 responses, the only significant differences in responses were that D1’s identified the need to perform “at the top of the class” academically as a greater barrier. D1’s also identified the motivating factor of “lifestyle after residency” as being more important than their D4 counterparts. Despite these two differences, the two groups largely agreed on perceived barriers and motivating factors. Finally, though only 9/115 of the D4’s surveyed chose to apply to OMS residency (7.83%). They identified having an OMS mentor and participating in women OMS specific events and conferences to be important aspects of their decisions to apply. Highest barriers identified were family sacrifices during residency, time commitment of residency, gender bias/avoiding discrimination, and social sacrifices during residency. Most significant motivating factors were scope of field/interesting procedures, respect, and financial security.
Multi-scale characterization of conventional and immediate dental implant systems

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OBJECTIVES
Clinical cases of dental implantation immediately after tooth extraction increases because it can reduce treatment time and procedures without a post-extraction healing period. However, it is controversial whether mechanical and biological stability of the immediate implantation are comparable to those of the conventional implantation. Thus, objective of this study was to characterize immediate and conventional implant systems at multi-scale.

METHODS
Following IACUC approval, 4 beagle dogs (1 year old male, 10-12 kg) with permanent full erupted dentition were obtained. First mandibular molars (M1) were extracted from each animal. After 3 months of healing, mandibular premolars (P4) were extracted, and screw-type Ti dental implants were bilaterally placed on the same day. The implant stability quotient (ISQ) were measured at the times of implantation and euthanasia at 3 and 6 weeks of post-implantation. Bone-implant constructs were dissected and subjected to micro-computed tomography (micro-CT). The construct was further dissected through the center of the implant and ground for nanoindentation. An array of 3 x 20 indentations were performed to measure modulus (E) at 30 mm from the implant surface up to 600 mm. Paired t-tests and mixed model analysis of variance were conducted to compare the conventional and immediate implant groups with p<0.05.

RESULTS
Micro-CT images could identify the 3D bone-implant interface with less metal artifacts. The ISQ values were not significantly different between conventional and immediate groups at 0, 3, and 6 weeks of post-implantation (66.55±9.15, p>0.08). The E value was significantly higher for the immediate implant group at both 3 weeks (10.5±81.7 GPa vs 6.01±2.22 GPa) and 6 weeks (13.32±3.29 GPa vs 10.23±1.85 GPa) of post-implantation (p<0.001).

CONCLUSION
While the quantity of bone surrounding immediate implant may be smaller than conventional implants, the increased quality of bone can contribute to their comparable ISQ values between immediate and conventional implant systems.
Orthodontic Tooth Movement Changes
Alveolar Trabecular Bone Mineral Density

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OBJECTIVES
Orthodontic tooth movement triggers active bone modeling and remodeling. As a result, changes of bone mineral density (BMD) distribution surrounding tooth can provide an insight of clinical status during orthodontic treatment. Thus, the objective of this study was to examine whether the BMD distribution of alveolar bone (AB) next to teeth changes during orthodontic treatment.

METHODS
After IRB approval, clinical cone-beam computed tomography (CBCT) images were obtained from 11 patients (1 male, 14.7 years old and 10 females, 15 ± 4.5 years old) who were taken by orthodontic treatment for 9 to 24 months. Three voxel layers of AB surrounding the left maxillary first molar (#14) before and after orthodontic treatment. A gray value that is proportional to BMD were obtained for each voxel layer with 0.4 mm of voxel size. A histogram of gray values was used to measure mean, standard deviation, and 5 percentile low and high (Low5 and High5) gray values. A paired t-test and Pearson’s correlation were performed to compare the gray values before and after treatment. Significance was set at p<0.05.

RESULTS
The mean and High5 gray values at the outermost 3rd layer significantly increased after treatment (p<0.015). Other gray value parameters were not significantly different at each layer and all parameters were not correlated before and after treatment (p>0.08).

CONCLUSION
The 3rd layer that is located 0.8 to 1.2 mm from the tooth root, contains trabecular bone. As a result, the current findings suggest that the trabecular region changes more than the lamina dura (next to the tooth root) with orthodontic treatment.
OBJECTIVES
Osteoporosis is characterized by decreasing loss of bone and bone mineral density (BMD) with aging. Many studies have observed the BMD changes of orthopedic bones but relatively less studies have been performed for oral bone. Thus, the objective of this study was to investigate age-related changes of BMD for alveolar bone (AB) and basal cortical bone (CB) at left lower premolar and left mandibular condyle using dental cone beam computed tomography (CBCT).

METHODS
After approval of IRB, CBCT scans from 84 patients (34 males and 50 females, 20 to 70 (49.83±14.64) years old) were acquired. The AB and CB regions around the lower left premolar roots and left mandibular condyle with the height of 7 mm from the condyle top to the occlusal plane were digitally isolated using imaging software (ITK SNAP). Volumes of each region were obtained by counting voxels and a CT attenuation value (gray value), which is proportional to bone mineral density (BMD), was assessed for each voxel. Pearson's correlation was tested between the volume and mean gray value of each region with age. The significance was set at p<0.05.

RESULTS
The mean gray value of the left lower premolar (AB) significantly decreases with age (r = -0.46, p = 0.001), while its volume significant increase (r = 0.396, p = 0.006). All other correlations were not significant (p>0.066).

CONCLUSION
The current finding indicates that oral bone may not substantially change with aging.
Alkaline Phosphatase Reduces Dentoalveolar Defects in X-linked Hypophosphatemia in Mice

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OBJECTIVES
X-linked hypophosphatemia (XLH) results from mutations in PHEX and causes rickets, osteomalacia, and dentoalveolar mineralization defects in dentin, cementum, and alveolar bone. Current therapies have limited efficacy on dentoalveolar tissues, suggesting unaddressed mechanisms of disease. Increased production of pyrophosphate and osteopontin (OPN), both mineralization inhibitors, may contribute to XLH-associated mineralization defects. Tissue-nonspecific alkaline phosphatase (TNAP) reduces pyrophosphate levels and dephosphorylates OPN. We hypothesized local TNAP injection would improve dentoalveolar development and alveolar bone healing in the Hyp mutant mouse model of XLH.

METHODS
Mineralized tissue-targeted TNAP (asfotase alfa, 100 mg/ml) was used in developmental and alveolar bone healing studies. For developmental studies, TNAP or saline was delivered to wild-type (WT) and Hyp mice (n=4-6/group) twice weekly via mandibular submucosal injection (2.5-3.5 µl/side) from 7-60 days post-natal (dpn). For healing studies, maxillary first molars were bilaterally extracted from Hyp and WT mice at 42 dpn. Collagen gel alone or with TNAP (n=4-7/group) was delivered to sockets. TNAP was additionally delivered to buccal mucosa (3.5 µl/side) at 7 and 14 days-post procedure in some mice. Tissues were collected for micro-computed tomography (micro-CT) and histology.

RESULTS
Developmentally, delivery of TNAP improved Hyp mouse dentin/cementum volume by 20-30% and normalized alveolar bone volume to WT levels by an improvement of 20%. In the extraction model, untreated Hyp mice demonstrated dramatically impaired alveolar bone healing vs. WT mice. Delivery of TNAP only at extraction did not improve healing in Hyp mice; however, additional local weekly TNAP delivery increased alveolar bone volume and density over Hyp controls. Interestingly, TNAP increased alveolar bone volume by 15% in WT mice.

CONCLUSION
TNAP therapy improved developmental dentoalveolar and alveolar bone healing defects in Hyp mice. This finding provides new insights into the pathological mechanisms underlying XLH and encourages more research into TNAP as an adjunct therapy in XLH.
OBJECTIVES
The human oral cavity is occupied by a diverse microbiome which is associated with health and disease. To better capture its variation and complexity at the species level, the identification and cataloging of naturally occurring bacterial isolates is necessary to conduct further research. To accomplish this, we obtained a variety of oral bacterial species from culturing and selecting individual bacterial colonies on a common lab medium (BHI). We identified selected isolates as well as phenotyped based on growth profiles and biofilm formation.

METHODS
Bacterial isolates were obtained from a dilution series of commercially available pooled human saliva plated on BHI medium. Colonies were selected based on their varying morphologies. The 16S rRNA gene was amplified through PCR and purified through centrifugation. The PCR fragment was sent for sequencing and the species identity was selected using BLAST homology search. To begin phenotyping the isolates, TY, TY-saliva and TY-water were inoculated with selected isolates and growth was characterized.

RESULTS
Over 100 isolates were collected which comprised seven total genuses and twenty-three total species. Our phenotyping showed significant variation in growth profiles and doubling times across media conditions. There was an overall preferential growth for the isolates in TY-saliva, although some exceptions were observed.

CONCLUSION
The study was successful in isolating a variety of species known to occupy the human oral cavity that are found in saliva and dental plaque. This data strengthens our understanding of the diversity of the microbiome and species of interest can now be tested for further characterization. By identifying naturally occurring species of the oral microbiome, with further testing, we can continue to understand the complex interactions within the human oral cavity and how they are associated with health and disease.
Impact Of E-Cigarettes On Subgingival Microbial Colonization

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OBJECTIVES
There is an alarming increase in the rate of e-cigarette use in the USA, accounting for usage by 4.5% of American adults as per 2023 CDC statistics. The objective of our study was to explore the effect of e-cigarettes usage on de novo colonization of the subgingival microbiome in systemically and orally healthy individuals.

METHODS
A 8-week prospective, case-control study was performed on 16 periodontally and systemically healthy volunteers, with an equal number of e-cigarette users and non-user controls. Subgingival plaque samples were obtained from both the groups at 1, 2, 4, 7, 14, 21 and 42 days subjected to whole genome shotgun sequencing.

RESULTS
The subgingival microbiome of e-cigarette users demonstrated greater diversity both functionally and taxonomically from the early days of microbial colonization. The microbiome demonstrated significantly greater volatility when compared to non-vapers. Several genes, especially those encoding metal efflux, antibiotic resistance and biofilm synthesis, were enriched early in colonization and remained at higher levels when compared to controls.

CONCLUSION
Within the context and limitations of the current study, e-cigarettes can cause significant shifts in the oral microbiome, with enrichment of several virulence traits. There is a need for additional research regarding the impact of e-cigarettes in oral health. There is also a need to make clinicians and patients more aware of the effects and possible complications of e-cigarette usage in oral wound healing.
OBJECTIVES
Athletes engaged in sports activities face a heightened susceptibility to orofacial injuries. Evidence has uncovered that sports injuries compose nearly one third of all facial injuries. The use of mouthguards demonstrated a reduction of oro-facial injury up to 56%. Traditionally, mouthguards are fabricated using custom molded Ethylene Vinyl Acetate (EVA) materials to achieve protection through the high impact absorption property of the material. With the advent of computer-aided design and computer-aided manufacturing (CAD/CAM) technology, new materials have been developed to allow additive manufacturing of mouthguards. One of those materials is Polyolefin, which is dispensed through fused deposition modeling (FDM) 3D printing to fabricate custom fitted athletic mouthguards. The aim of the study is to investigate the impact absorption and ability to dissipate forces of conventionally molded EVA compared to 3D-printed polyolefin materials using the IZOD ASTM D256 impact test.

METHODS
Five molded and two 3D-printed material sample groups were fabricated following a modified version of ASTM D256. A total of twenty 3D-printed samples and thirty molded samples were prepared. Impact absorption testing was completed at The Ohio State University CDME employing a benchtop Izod impact striker machine. Statistical analysis, including mean, median, and standard deviation were completed.

RESULTS
3D-printed mouthguard Polyolefin materials demonstrated significantly (p<0.05) higher Izod Impact Strength than the molded compounds. Additionally, laminar separation was observed on all 3D-printed samples test specimens. No cracking or tearing was observed on any of the molded compound materials.

CONCLUSION
In conclusion, this study presented mixed performance of the Polyolefin material in comparison to molded EVA. 3D-printed mouthguard polyolefin materials exhibited significantly higher Izod Impact Strength than molded compounds (p<0.05). However, laminar separation was evident in all 3D-printed samples, contrasting with the absence of cracking or tearing in molded compound materials.
Artificial Intelligence-assisted caries detection of bitewing radiographs: a review.

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OBJECTIVES
Multiple studies have proved the efficacy of artificial intelligence (AI) in the detection of caries of bitewing radiographs (BWRs). This important capability has the potential to standardize caries detection, improve the dentist’s diagnostic ability, and subsequently improve patient care.

METHODS
With the focus on AI-assisted caries detection for the general dentist, specifically of BWRs, this review begins with a brief explanation of AI, discusses the benefits and disadvantages of its use, and then touches on ethical and privacy concerns. Thereafter, it summarizes current research, discusses commercial products presently available, and finally summarizes the findings of experimental studies using mobile devices to detect caries.

RESULTS
AI, in the context of dental imaging, refers to the utilization of algorithms and machine learning techniques to analyze radiographic images. The integration of AI in caries detection has the potential to streamline and enhance diagnostic accuracy. In reviewing current research, various studies have substantiated the efficacy of AI in caries detection on bitewing radiographs. Additionally, commercial products incorporating AI for this purpose are now available, offering dentists practical tools for implementation. Experimental studies exploring the use of mobile devices for AI-assisted caries detection further expand the potential applications of this technology.

CONCLUSION
In conclusion, AI-assisted caries detection, particularly in BWRs, represents a transformative development in dentistry. While it brings numerous benefits, ethical considerations and privacy concerns warrant careful attention. The ongoing evolution of AI technologies in dentistry holds the promise of continued advancements, contributing to improved diagnostic accuracy and enhanced patient outcomes.
Estrogens have long been implicated in the maintenance of bone and joint health. However, sexually dimorphic effects often exist most likely due to the relation and relative importance of testosterone to estrogen. Current estradiol-17-beta estrogen replacement therapies are not recommended for males due to their feminizing effects. Estradiol-17-alpha is an E2 estrogen isoform that has recently gained attention for its ability to extend male animals’ lifespan and health-span without feminization. However, its potential effects on the skeletal system have not been thoroughly investigated. We hypothesized that 17-alpha administration to males would slow age-related declines in bone and joint health. Male HET3 mice were fed 14.4ppm estradiol (17-alpha E2) via standard chow over 19 weeks prior to euthanasia at 60- or 105-weeks-old (middle and old, n=6-11/group). Untreated young (20-week-old), middle, and old males were given only standard chow (n=9-12/group). Following euthanasia, left knees were harvested for joint degradation assessment via microCT, blinded microCT reconstruction grading (0=healthy, 3=severe deterioration), and histology. Right femora were harvested for bone structure and strength analysis via microCT and mechanical testing (3-point bending). As young-treatment group data is currently unavailable, data from the middle and old groups were analyzed via two-way ANOVA (factors: age, treatment) and a one-way ANOVA (factor: age) was used to look for age differences. The histology and mechanical testing are still on going. Anticipated significant increases bone size were evident in all microCT outcomes. However, there were no significant treatment effects for any microCT outcome or blinded damage score. This agrees with other recent studies suggesting little effect of 17-alpha treatment on osteoarthritis in older HET3 animals (~130 weeks). Ongoing mechanics or micro-scale analyses may be sensitive enough to reveal improvements not captured at the tissue-scale.
Gender dependent functional demands change oral bone mineral density

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OBJECTIVES
Bone mineral density (BMD) is changed by bone modeling and remodeling. For oral bone, masticatory functional demand can trigger active bone turnover around each tooth. Thus, the objective of the study was to examine whether the masticatory functional demand changes the oral BMD distribution differently between genders.

METHODS
Following IRB approval, 77 clinical cone beam computerized tomography (CBCT) images were analyzed for 42 female and 35 male patients between ages 20 and 82 years old. Bone voxels were segmented from non-bone voxels using an imaging software (ITK Snap). Mandibular alveolar bone (AB) regions of incisors and left first premolar in the mandibular arch were digitally isolated within 1.2mm surrounding the root. The basal cortical bone (CB) regions of the same teeth were determined at 0.6 mm inside the mandibular bone borders. The mean gray value, which is proportional to bone mineral density (BMD), was measured for each bone voxel. A paired t-test and Pearson’s correlation were performed to compare the values of the two sites in male and female groups. Significance was set at p<0.05.

RESULTS
The mean gray value of AB was significantly higher at the incisor than that at the premolar for both male and female groups (p<0.001) while that of CB was not significantly different (p>0.956). The volume of AB at the premolar was significantly higher than that of the incisor for the female (p=0.001) but it was not significantly different for the male group (p=0.065). All values between the two sites were significantly correlated for the male group (p<0.007) but the AB volume and mean gray value of CB were not significantly correlated (p>0.154).

CONCLUSION
Oral BMD is an important surrogate to estimate mechanical stability of teeth under mastication. The current findings indicate that BMD distribution differs between genders, which helps develop a patients specific treatment plan.
A Retrospective Exploratory Study on Periodontitis and Cardiovascular Diseases

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OBJECTIVE
Although causative evidence is nonexistent between periodontal (PD) and cardiovascular diseases (CVD), associations exist for both disease progressions. Severe PD may induce systemic inflammation. Factors including smoking, obesity, endocrine-related diseases (ED), hyperlipidemia and socioeconomic status have been shown to correlate with PD and CVD. The objective of this retrospective study is to investigate co-existence of these two chronic inflammatory diseases within the patient population of a training center.

METHODS
Patients diagnosed with Stage 3-4 and Grade C periodontitis, localized/generalized distribution at the Advanced Training Program in Periodontics (IRB protocol #2023E0756), were recruited through Axium and subcategorized into four groups: ≤34 yrs; 35-44 yrs; 45-54 yrs; 55-64 yrs. Exclusion criteria included >64 due to increased edentulism resulting from non-periodontal issues. Compliance with medical and dental follow-up, oral hygiene, smoking and alcohol status were documented. Patient-reported CVD (hypertension, congestive heart failure, tachyarrhythmias/bradyarrhythmia, coronary artery disease, peripheral vascular disease, valvular diseases), ED (diabetes, hyper/hypo-thyroidism, adrenal insufficiency/hyperplasia) and CVD/ED medication use were recorded. Descriptive statistics were used for preliminary data analysis.

RESULTS
66 charts (36 male, mean 49±10 yrs, diagnosed with Stage 3 [57] and Stage 4[9] periodontitis) were included for data analysis. Age categories included: ≤34yrs(7), 35-44yrs(16), 45-54yrs(32), 55-64yrs(11). Compliance with physical and dental checkups were 71%(47) and 48%(32) respectively. 48.5%(32) were active smokers and 45.5%(30) were self-described social drinkers. 30%(20) and 21%(14) of patients reported CVD and ED, respectively. 71%(47) and 79%(52) patients report being nonmedicated for CVD and ED, respectively. The distributions of CVD and ED within each age bracket were: ≤34yrs(14 and 0%), 35-44yrs(6 and 19%), 45-54yrs(34 and 16%); 55-64yrs(64 and 55%). Data collection and analysis are ongoing.

CONCLUSION
Most patients diagnosed with severe forms of periodontitis report CVD and/or ED that are not treated with medications. Risk-contributing environmental factors for both diseases co-exist with the actual diagnoses of these chronic inflammatory diseases.
Benign Fibro-Osseous Lesions of the Jawbones (BFOLJ): A Clinicopathologic Analysis of 518 Cases from a Single Institution

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OBJECTIVES
BFOLJ represent a heterogeneous group of conditions with overlapping clinico-radiographic and histopathologic features despite diverse etiopathogenesis and biologic behavior. Overall, BFOLJ are subclassified into cemento-osseous dysplasia (COD), (cemento-)ossifying fibroma (OF) and fibrous dysplasia (FD). Herein, we present our institutional experience regarding the epidemiologic and clinicopathologic characteristics of BFOLJ.

METHODS
Archived BFOLJ cases diagnosed over a 22-year period (2000-2022) were retrieved from the electronic laboratory databases of Oral Pathology Consultants at The OSU. Available information regarding patient age and gender, anatomic location, lesion focality, radiographic appearance, and histopathologic diagnosis was recorded and used for analysis.

RESULTS
A total of 518 BFOLJ cases were identified with 440 (85%) affecting women and 78 (15%) men (F:M=5.6:1; age range=4-92y, mean=40.5y). The mandible was involved in 86% and the maxilla in 14% of the cases with the posterior mandible being the most common site (304, 57%). Among 123 BFOLJ with available clinico-radiographic information, 101 (82%) appeared unifocal and 22 (18%) showed multifocality with 63% of the cases presenting as well-defined, mixed radiopacity/radiolucency, 23% as unilocular radiolucency and 14% as radiopacity. Most BFOLJ were diagnosed as COD (449, 86.7%; F:M=7.8:1; age range=11-92y, mean=43y) further subcategorized as focal (292, 65%), florid (46, 10.25%), periapical (19, 4.25%), and COD NOS (92, 20.5%). Other diagnoses included OF (33, 6.4%; F:M=1:1; age range=4-47y, mean=26y), FD (28, 5.4%; F:M 3:1, age range=8-66y, mean=31y), juvenile OF (7, 1.3%) and renal osteodystrophy (1, 0.2%). Thirty (5.8%) BFOLJ were associated with secondary lesions, chiefly traumatic bone cyst (18, 60%), followed by central giant cell lesion (4, 13.3%) and xanthoma of bone (3, 10%).

CONCLUSION
BFOLJ are relatively uncommon and largely represent forms of COD with a strong predilection for the posterior mandible of middle-aged women. Histopathologic examination and clinico-radiographic correlation are required for accurate diagnosis and proper management.
Impact of High Phosphate Diet on Bone Mechanical Stability and Fracture Risk

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OBJECTIVES

High consumption of processed foods can lead to an increase in the concentration of inorganic phosphate (PI) in the bloodstream. While prior research has demonstrated that elevated PI levels may lead to chronic kidney disease, adverse cardiovascular complications, and skeletal muscle dysfunction, there is limited understanding regarding its effects on bone health. This study aims to investigate whether a high phosphate diet can influence the mechanical stability and risk of bone fracture in the mandible and femur of a mouse.

METHODS

Following IACUC approval, twenty male C57BL6N mice (20 to 24 week old) were allocated into two groups: normal phosphate diet (NP; n=10) and high phosphate diet (HP; n=10), with dietary phosphate contents of 0.9% and 2.3% total PI, respectively for 12 weeks. Four mandibles (2 from each group) and eighteen femurs (9 from each group) were randomly selected for static loading, dynamic mechanical analysis (DMA) and fracture test. Non-destructive compressive static displacement was applied to the teeth and femurs, with cyclic loading (-0.01 ± 0.005 mm at 0.5 to 3 Hz). Various parameters, including static elastic stiffness (K), hysteresis (W), dynamic complex stiffness (K*), and tangent delta (representing energy dissipation ability), were measured. Furthermore, the same femurs were subjected to fracture testing with a bending displacement of 0.5 mm/sec. The resulting load-displacement curves were used to assess maximum force (F_max), displacement (d_max), and toughness (U) of each sample. Statistical analysis was conducted using a t-test to compare the NP and HP groups, and Pearson’s correlation tests were employed to investigate the relationship between F_max and other parameters. Significance was set at 0.05. The HP group exhibited significantly lower static stiffness (K), dynamic stiffness (K*), energy dissipation (tan delta), and F_max compared to the NP group (p<0.05).

RESULTS

The stiffness (139.84±24.42 N/mm) and energy dissipation (0.049±0.004) of the HP group were found to be significantly reduced compared to those of the NP group (stiffness: 196.44±35.18 N/mm and energy dissipation: 0.055±0.008) with a p-value of ≤ 0.05. The HP group had significantly lower value of F_max than the NP group (16.92±5.75 vs 22.28±3.52, p=0.03). The F_max had significantly positive correlations with static and dynamic stiffness but a negative correlation with viscoelastic energy dissipation (tan d) for the NP group (p<0.03).

CONCLUSION

The findings of this study suggest that a high dietary phosphate intake likely diminishes the mechanical stability of bone, thereby increasing the risk of fractures. Ongoing research employing a larger sample size, particularly with an emphasis on jaw bones, is currently in progress.
Denture Digitization Protocols: Comparison of Trueness and Efficiency
Sawangsri, Leelaluk, Hsieh, Lee

OBJECTIVE
There are multiple ways to digitize complete prostheses, however, there are no comparative studies of these methods. This study aims to compare trueness and efficiency of different digitization protocols.

METHODS
10 maxillary and 10 mandibular complete prostheses (n=10) were fabricated and fiducial markers were attached to each prosthesis. References scans were obtained by desktop laboratory scanner (3shape E4). Test scans were obtained using the 3 different techniques: intraoral scanner (trios 3) with manufacturer’s scan strategy, intraoral scanner with rolling scan strategy, and intraoral scanning-PVS putty technique. The total scan time was recorded for efficiency analysis. Using Geomagic control X, reference scans were segmented. Corresponding test scans were superimposed to the reference scan using overall best-fit, intaglio best-fit, and dentition best-fit. For trueness analysis, the Root mean square value (RMS) of overall best-fit, intaglio best-fit, and dentition best-fit superimposition were calculated. One-way ANOVA was used followed by Tukey post hoc test were used for trueness and efficiency analysis. Qualitative analysis of trueness was performed using 3D color mapping.

RESULTS
The lowest RMS value was found in mandibular scans with rolling strategy when using overall best-fit (0.098 ± 0.012 mm.). The highest RMS value was found in mandibular scans of intraoral scanner-PVS putty technique when using intaglio best-fit (1.459 ± 0.094 mm.). The shortest digitization time was when rolling technique used to digitize maxillary prostheses (2.478 ± 0.556 min.). The longest digitization time was when the manufacturer’s scan strategy used to digitize maxillary prostheses (3.342 ± 0.702 min.). Qualitative analysis revealed that deviation in intraoral scanner-PVS putty technique occurred around the border area of the prostheses.

CONCLUSION
There is no significant difference in trueness between the manufacturer’s and rolling scan strategies, whereas the intraoral- PVS putty produces significantly more error than other techniques (P>0.05). However, the time taken to digitize mandibular prostheses using rolling technique was the shortest among the three protocols.
Dental Implantation Changes Bone Mineral Density of Mandibular Condyle

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OBJECTIVES
Temporomandibular joint osteoarthritis (TMJOA) is an important subtype of TMJ disorders which can cause pain and dysfunction of the joint. While TMJOA is diagnosed in all populations and age groups, the exact etiology for this multifactorial joint disease has not been fully elucidated. The objective of this study was to examine whether replacement of teeth with dental implants has an effect on the risk of TMJOA.

METHODS
Following IRB approval, cone beam computed tomography (CBCT) images were obtained retrospectively from 306 patients. CBCT images of 11 patients, who were longitudinally scanned before dental implant placement and restoration, and more than 3 months post-implantation, were analyzed. Left and right TMJ condyles were digitally isolated from the images. A histogram of gray level that is proportional to bone mineral density (BMD) was obtained from each image. BMD parameters including mean, standard deviation (SD), fifth percentile low and high values (Low5 and High5) of the gray level histogram were determined. The surface of the condyle was identified into 9 regions. Clinical examiners counted the number of regions per condyle with TMJOA related pathogenic changes. Lateral cephalograms were digitally cropped from the CBCT images and were used to compare skeletal morphology. Paired t-tests were performed to compare the longitudinal measures with p<0.05.

RESULTS
Post-implantation patients had a significantly lower mean BMD and Low5 gray values in the condyles compared to pre-implantation patients (p<0.03). TMJOA counts had a marginally significant increase in post-implantation patients (p=0.06).

CONCLUSION
After implantation, the patients had a decrease in BMD of the condyle with an increase in TMJOA counts. This association suggests that an implant-altered occlusion likely results in the bony changes of the condyle.
Assessment of Enamel Microarchitecture in ADAM10 Conditional Knockout Mice

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OBJECTIVES
A Disintegrin And Metalloproteinase Domain-10 (Gene: Adam10; protein: ADAM10) is a transmembrane enzyme that is expressed during the early stages of enamel formation. Global deletion of Adam10 in mice leads to embryonic lethality, hindering efforts to study its role in enamel development. The objective of this study was to analyze the structural changes in enamel using an Adam10 conditional-knockout (cKO) mouse.

METHODS
Adam10 was conditionally deleted from ameloblasts by breeding floxed Adam10 (Adam10⁰⁻) mice with Amelx-iCre mice to generate Amelx-iCre; Adam10⁰⁻ conditional knockout (cKO) mice. At 7 weeks, mandibles were harvested from wild-type (WT; Adam10⁰⁻) and cKO mice. Physical and surface characteristics of enamel were assessed by micro-computed tomography (µCT) and backscattered scanning electron microscopy (bSEM).

RESULTS
µCT analysis of molars revealed a severely hypomineralized enamel layer that was indistinguishable from the underlying dentin. Signs of occlusal wear were observed on molar cusp tips indicating an abnormal loss of enamel. A greater reduction of enamel volume and density was seen in cervical region of cKO molars compared to WT. Comparison of unerupted incisor regions reveal a 13% reduction of enamel density (***P< 0.001) and a 10% decrease in thickness (**P< 0.01) in cKO vs WT mice. bSEM of WT incisors was highly mineralized and of normal thickness. In contrast, enamel from Adam10 cKO incisors was thinner and darker. The degree of hypomineralization became progressively more severe in cKO incisors from the dentin-enamel junction (DEJ) to the incisal edge. Distinctively organized and decussating enamel rods were observed in WT incisors, whereas the prism pattern in cKO incisors was loosely arranged and highly disorganized.

CONCLUSION
Conditional deletion of ADAM10 leads to compromised enamel quality, quantity and loss of enamel prism structure. These results highlight an important role of ADAM10 in enamel formation.
Streptococcus sanguinis Carbohydrate Utilization Pathways Impacts Competition with Streptococcus mutans

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OBJECTIVES
Within dental plaque biofilms, interactions between oral streptococci, including the caries-associated Streptococcus mutans and health-associated commensal Streptococcus sanguinis, influence health and disease states. Previously, we found that commensal streptococci compete with and suppress S. mutans by utilizing accessible carbohydrates. We hypothesized that these genes are crucial for suppressing S. mutans growth, but it remains unclear how the loss of these genes impacts the phenotype of S. sanguinis. In this study, we aimed to determine if the inactivation of carbohydrate utilization pathways in S. sanguinis affects the level of competition against S. mutans.

METHODS
From previous RNA-Seq co-culture data, three significantly upregulated genes of S. sanguinis were selected for allelic exchange with an antibiotic marker to construct mutant strains. The growth of these strains was compared in both TYG and TYG supplemented with human saliva (HS). Biofilm formation was also measured in both monocultures and in coculture competition against S. mutans. Finally, the fitness of each mutant was analyzed through competitive index assays with S. mutans.

RESULTS
When grown in TYG, we observed a significant decrease in growth rates for most mutant strains compared to the wild-type S. sanguinis control. However, growth patterns differed when grown in TYG with HS. Biomass assays also revealed differences in biofilm formation among the mutant strains. In TYG, the competitive fitness assay showed a decrease in S. mutans fitness when in competition with most mutant strains. However, in TYG with HS, the fitness of S. mutans increased.

CONCLUSION
This study's results provide insight into the role of commensal carbohydrate utilization in suppressing S. mutans growth. The study emphasizes both the importance of evaluating interspecies interactions in growth conditions that better represent their in vivo environment and the roles of various pathways influencing fitness. By examining intermicrobial interactions, we can better understand the factors shaping our oral microbiome.
In Utero Electronic Nicotine Delivery System Exposure Alters Skull Development in a Mouse Model

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OBJECTIVES
This study seeks to understand the varied effects of Electronic Nicotine Delivery Systems (ENDS) when used during pregnancy for development. Data suggests these exposures may cause craniofacial growth disturbances. ENDS have now entered the market with little regulation and are being promoted as safe and are being used by pregnant people. As 11% of women continue to smoke and 1 in 20 report using ENDS during pregnancy, ENDS may be viewed as a safer alternative to cigarette smoking. Our understanding of the effects of ENDS components (nicotine, carrier formulations, and vaporization by-products) on the developing fetus is poor. We aim to establish an expandable model of ENDS exposure to determine if use results in altered craniofacial growth. We hypothesize that a formulation of ENDS with 20mg/ml of nicotine and a 30/70 ratio of Propylene Glycol/Vegetable Glycine (PG/VG) when exposed in utero will lead to alterations in growth.

METHODS
Wild type pregnant mouse dams were used to produce litters that were exposed in utero (E0.5-term) to free air (control), a 30:70 PG:VG carrier ratio with no nicotine, or to ENDS (30/70 PG/VG volume ratio, 20mg/ml concentration amount of nicotine). MicroCT images were obtained on perinate skulls at post-natal day 14 (PN14). Scans were collected on 101 perinates. Murine skull MicroCT images were further subject to cephalometric analysis to assess changes in the cranial base and facial region.

RESULTS
Weight was observed to be significantly different with the 30/70 carrier group observed to weigh less than the free air control (p=0.046). Cephalometric results showed a significant reduction in growth in the 30/70 PG/VG carrier in multiple measurements relative to the free air control group, including craniofacial length, nasal height and length, cranial length and width, facial widths, and cranial base length (p<0.05).

CONCLUSION
The results suggest an effect of 30/70 PG/VG carrier exposure on the developing calvaria and face. Oddly no effect was observed when nicotine was added to the carrier approximating an ENDS exposure. This is in contrast to previous findings in a different ENDS formulation (50/50 PG/VG) suggesting formulation may play a critical role in the negative effects of exposure. Future research will seek to extend these models to vary both PG/VG ratio formulation, nicotine concentrations, and other common ENDS components.
Conditional Ablation of Bone Sialoprotein Affects Cranial Growth

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OBJECTIVES
Bone sialoprotein (Ibsp gene; BSP protein) is an extracellular matrix protein found in mineralized tissues. Global deletion of Ibsp (Ibsp⁻/⁻) in mice led to impaired long bone growth and mineralization; however, the craniofacial phenotype of Ibsp⁻/⁻ mice revealed an arguably more critical role of BSP in alveolar bone mineralization. These data suggest BSP may have different roles in intramembranous vs. endochondral ossification. In the skull, young Ibsp⁻/⁻ mice possess slightly defective intramembranous mineralization, characterized by increased suture width; however, defects on endochondral ossification in Ibsp⁻/⁻ crania have not been investigated, and the underlying mechanism(s) remain unclear for the described intramembranous defect. We hypothesize BSP is more critical for intramembranous vs. endochondral mineralization of the skull.

METHODS
We developed a mouse carrying a floxed Ibsp allele and conditionally deleted Ibsp from 1.) neural-crest derived ectomesenchyme using Wnt1-Cre mice and 2.) mesoderm using Prx1-Cre mice. Skulls were harvested from wild-type (WT; Ibsp⁺/+ and conditional-knockout (cKO; Wnt1-Cre;Ibsp⁰/⁰ and Prx1-Cre;Ibsp⁰/⁰) mice (n=3/group/timepoint) at 14 and 30 days-post-natal (dpn). Standard murine cranial landmarks were used to collect 3D coordinate data from micro-computed tomography scans. Interlandmark distances were calculated to evaluate size differences.

RESULTS
Cranial length was significantly reduced in 14 dpn BspWnt-cKO mice; however, at 30 dpn, no difference was observed. Several distances trended (defined as p=0.05-0.1) toward being reduced in 14 dpn BspWnt-cKO mice, including nasal and frontal bone length as well as foramen magnum width. Nasal bone length, cranial length, and spheno-occipital suture length all trended toward being reduced in 30 dpn BspPrx1.

CONCLUSION
BspWnt-cKO mice trended toward reduced measurements of intramembranous ossified structures. While BspPrx1 trended toward reduced measurements of endochondrally derived structures, several intramembranous structures were also affected. Further analyses are underway to increase the sample size and evaluate shape differences between BspWnt-cKO and BspPrx1-cKO mice.
Variation in Interspecies Interactions Amongst Clinical Isolates of Streptococcus mutans

Kacee Soehnlen, Justin R. Kaspar

OBJECTIVES
Dental caries is the most common noncommunicable disease worldwide, affecting both children and adults. *Streptococcus mutans* is closely associated with the formation of dental caries due to its acidogenic and aciduric properties. Our group has collected twenty different clinical isolates of *S. mutans* that display differences in biofilm formation phenotypes. The focus of this project was to determine if the differences in characteristics of *S. mutans* isolates carried over to fitness during interspecies interactions. To begin to examine this, we cocultured twenty different *S. mutans* isolates with 10 different species of oral bacteria and examined changes in interaction patterns.

METHODS
Biomass accumulation of the *S. mutans* isolates with interaction partners was quantified with the crystal violet (CV) assay. After, variability in biomass gain or loss between the isolates for each interaction partner was examined and interactions with *Lactobacillus casei* were more closely examined using wide field fluorescent microscopy. Differences in cell biomass, colony morphologies, and extracellular matrix amount and distribution were quantified.

RESULTS
Variability in isolate coculture biomass was low with various oral streptococci interaction partners, but high in coculture containing *L. casei*. Through microscopy of *S. mutans* isolate – *L. casei* biofilms, we found that total cell biomass did not vary between monoculture controls and cocultures. However, in two of the isolates, SMU 159 and SMU 058, extracellular matrix accumulation decreased significantly.

CONCLUSION
In general, accumulation of biomass did not specifically vary for our panel of *S. mutans* isolates aside from interaction with *L. casei*. By microscopy, we found no significant change in biomass but change in biofilm matrix accumulation. The next step would be to expand our study by continuing to compare a large number of *S. mutans* isolates with *L. casei* to determine if the trend of changes in matrix production is consistent.
Tgfbr2 Deletion in Dental Pulp Reduces Tertiary Dentin after Injury
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Innervation and neuronal signaling are vital for many tooth functions, including development and repair. We previously established that transforming growth factor beta (TGFbeta) signaling from the dental mesenchyme regulated mineralization and innervation of developing mouse molars. In this study, we investigated mesenchymal TGFbeta signaling in pulpal healing of a shallow dentin injury. Previous research demonstrated calcitonin gene-related peptide (CGRP) positive axon outgrowth toward a shallow dentin injury, suggesting these axons are integral to healing. A recent follow-up study demonstrated that CGRP+ axon irritation resulted in pulp chamber hypercalcification. We hypothesized that mesenchymal conditional deletion of TGFbeta receptor 2 (Tgfbr2) using an Osterix-Cre recombinase (Tgfbr2cko) that reduced neurite outgrowth during development would similarly reduce neurite outgrowth in response to injury and reduce tertiary dentin formation by odontoblasts. The Tgfbr2cko mice were fed a doxycycline-enhanced diet from in utero until two weeks prior to surgery to inhibit the tetracycline-responsive Cre element and allow normal skeletal and dental development. A shallow dentin injury was made on the mesial side of the first mandibular molar of 3-month-old control and Tgfbr2cko mice, and hemi-mandibles were collected after 4, 8, 21, and 56 days post injury (dpi) (n=6-8). In situ hybridization for Sp7 (Osterix) transcripts confirmed Osterix-Cre expression and inferred Tgfbr2 deletion at 4dpi. Immunofluorescence and confocal imaging of CGRP+ axons did not demonstrate differences in axon outgrowth toward the injury in Tgfbr2cko molars compared to controls. However, microcomputed tomography and histology indicated visibly lower tertiary dentin in Tgfbr2cko molars. These results suggest that pulpal signaling downstream of Tgfbr2 does not regulate neurite outgrowth in response to injury, and peptidergic signaling from CGRP+ axons may not compensate for reduced mineralization capacity in Tgfbr2-deficient odontoblasts. Further investigations into the multicellular signals involved in pulp healing are planned to develop the foundation for precision-based, vital pulp therapies.
Antagonism of a Cariogenic Bacteria is Driven by Hydrogen Peroxide

Jacob Tuckerman, Justin R. Kaspar

OBJECTIVES
Commensal organisms can encode factors that inhibit the colonization of pathogens. One such example is the production of hydrogen peroxide via the enzyme pyruvate oxidase that converts pyruvate to acetate. In this conversion, hydrogen peroxide is generated as a byproduct. Several cariogenic species, such as Streptococcus mutans, are sensitive to the presence and amount of hydrogen peroxide produced by oral commensals within biofilms. Recently, our group identified a strain of Streptococcus mitis that when cocultured with S. mutans, completely inhibited S. mutans microcolony (biofilm) formation. We hypothesized that hydrogen peroxide production by S. mitis played a critical role. To test this, we evaluated biofilm formation of S. mutans in coculture with wild-type and a ΔspxB knockout mutants of S. mitis.

METHODS
Biofilm biomass accumulation, quantified through the crystal violet assay, was compared for the wild-type and ΔspxB in coculture with S. mutans. Addition of catalase to the media, to remove produced hydrogen peroxide, was also evaluated. Finally, we visualized coculture biofilms via widefield microscopy to observe differences in S. mutans biomass, microcolony count, and biofilm thickness.

RESULTS
Significantly more biofilm formation was recorded in cocultures of ΔspxB and those that included catalase compared to the wild-type controls. In addition, microscopy showed increased S. mutans biomass, microcolony number, and biofilm thickness.

CONCLUSION
Our data support the hypothesis that hydrogen peroxide production by S. mitis is the major determinant for inhibition of S. mutans biofilm formation in coculture. Future studies will determine why hydrogen peroxide production by this strain is extremely toxic to S. mutans – potentially through the amount of hydrogen peroxide produced due to strain variation. This study highlights how specific strains or oral bacteria can potentially prevent biofilm and subsequent caries formation. By looking at the connections between organisms in the oral microbiome, environmental factors linked to health and disease can be identified.
Mechanical Properties of Remodeled and Defect Bone at Implant Interface

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OBJECTIVES
A healing process following surgical placement of a dental implant involves active modeling and remodelling of the peri-implant bone tissues. When a critical size bone defect develops next to the implant, the stability of an implant system is reduced. The objective of this study was to examine whether the mechanical properties of interfacial bone tissues change with distance and are different between the normal and defect regions.

MATERIALS AND METHODS
Following IACUC approval, 3 histological slices of bone implant interface with marginal bone defect (4 mm depth) were prepared from 3 canine mandibular models (10-15 kg) after 2 months of post-implantation healing. Nanoindentation was conducted on the defect and the normal healing regions at the same interface. A total of 360 indentations with groups of 60 indentations was performed at distances between 30 μm and 600 μm from the surface of the implant. Elastic modulus (E) was obtained using a slope of load-displacement curve during unloading processes of indentation. An analysis of variance was used to compare mean values of E with distances away from the implant surface between normal interface and defect regions (p<0.05).

RESULTS
Normal and defect regions showed significant differences in values of E with distances from the surface of the implant. The defect regions had significantly lower and uniform values of E with distances than the normal implant interface region (3.41±0.67 GPa vs 8.73±3.67 GPa, p<0.001).

CONCLUSION
Higher elastic modulus accounts for increased mineralization of a bone tissue. The current findings indicate that the defect regions have newly formed less mineralized tissues than the normal interface. The uniform values of E in the defect region indicate that active bone turnover was not developed yet.
Effects of Orthodontic Treatment on Alveolar Bone Mineral Density

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OBJECTIVES
Tooth movement resulting from orthodontic treatments involves bone modeling and remodeling of the alveolar bone (AB) surrounding the teeth. During these processes, bone resorption removes existing mineralized bone tissues and bone formation adds less mineralized new bone tissues, therefore altering the distribution of bone mineral density (BMD) at the alveolar bone. The objective of the current study is to examine whether clinical cone beam computed tomography (CBCT) can detect the 3D BMD distribution changes at the AB from orthodontic treatment.

METHODS
Following IRB approval, CBCT images of 13 patients (1 male, 14.7 years old and 12 female, 15 ± 4.5 years old) were retrospectively obtained. The distribution of gray values was measured for alveolar bone surrounding both the left and right maxillary first molars (#3 and #14) before and after treatment of 16 ± 7 months. The alveolar bone was digitally isolated using ITK-SNAP imaging software. A histogram of gray values that are proportional to BMD was acquired from each image. Mean, standard deviation, and 5 percentile low and high (Low5 and High5) values were computed. A paired t-test and Pearson's correlation were performed to compare the gray values before and after treatment. Significance was set at p<0.05.

RESULTS
The mean and Low5 gray values significantly increased after treatment (p<0.02). All gray value parameters had significant positive correlations before and after treatment (p<0.005).

CONCLUSION
The changes of BMD distribution account for active bone modeling and remodeling that are triggered by orthodontic treatment. The current findings suggest that CBCT based assessment of 3D BMD distribution can provide a helpful diagnostic tool to improve orthodontic treatment.
Mechanosensitive Ion Channel Piezo2 Is Essential For Orthodontic Tooth Movement

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OBJECTIVES
Straightening a crowded alignment using orthodontic treatments has long performed over approximately 300 years. Although signaling cascades mediating alveolar bone remodeling responding to orthodontic force have been the center of interest in orthodontic research, molecular mechanisms underlying mechanical force-induced alveolar bone remodeling during orthodontic tooth movement has not clearly revealed yet. Multiple sensory afferents including nociceptive nerve fibers are projected to the periosteum. Approximately a quarter of periodontal afferents contain neuropeptides, such as substance P (SP). We previously reported that the afferent fibers express transient receptor potential vanilloid 1 (TRPV1), a receptor for capsaicin, as well. Although it is known that TRPV1-expressing peptidergic afferent fibers mediate the pain exerted from orthodontic force, the mechanistic role of peptidergic afferents during orthodontic force-induced alveolar bone remodeling is not well known.

METHODS
Orthodontic force produced in mice by a coil spring exerting a force of 10 grams was used.

RESULTS
Chemical ablation of TRPV1-expressing afferents decreased orthodontic tooth movement. Tooth movement was significantly reduced by deletion of tachykinin precursor 1 (Tac1), a gene that encodes SP, as well as by treatment of gingiva with SP antagonist. Interestingly, conditional knockout of Piezo2, a mechanosensitive ion channel, residing in TRPV1-expressing afferents also reduced tooth movement markedly.

CONCLUSION
The results suggest that orthodontic force induces mechanical activation of Piezo2 in TRPV1-expressing afferents, which in turn induces the release of substance P that likely initiate alveolar bone remodeling during orthodontic force. This study provides clues for the potential linkage between orthodontic force application and alveolar bone remodeling by exhibiting sensory nerves and mechanosensitive ion channel Piezo2 responding to orthodontic tooth movement.
Monitoring Competitive Interactions between Oral Streptococci in Altered Environments

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OBJECTIVES
Oral streptococci within dental plaque communities can be associated with health or disease. The caries-causing pathogen Streptococcus mutans has been studied primarily in monoculture; however, S. mutans does not naturally exist within the oral environment alone. RNA-Seq was used to pinpoint specific genes that were upregulated when S. mutans was grown in cocultures with health-associated oral streptococci. We hypothesize that these identified upregulated genes are important for the competitive fitness of S. mutans.

METHODS
Twelve different S. mutans strains with mutated genes of interest were grown for 24 h in a coculture with commensal streptococci, with growth monitored in a BioTek Synergy H1 Microplate Reader via fluorescent intensity of an integrated gfp gene. Growth of cocultures were also compared in TY- only and TY- that contained human saliva. Areas under the curve (AUC) were then calculated based on the individual fluorescent intensity readings over time to use for statistical analysis between individual strains and conditions.

RESULTS
We identified two out of eleven genes screened that displayed a significant loss of fitness compared to the parental strain. SMU.2027 is expected to encode for a LexA-like transcriptional regulator and SMU.2146c contains a transglycosylase-like domain that cleaves peptidoglycan. In addition, we determined that growth in media containing human saliva significantly increased the competitive behaviors of S. mutans.

CONCLUSION
We have identified that the loss of genes 2027 or 2146c resulted in a decreased fitness of S. mutans in coculture. This study emphasizes the importance of studying S. mutans in mixed-species settings. Additionally, we have identified a change in growth of S. mutans in cocultures with human saliva in comparison to TYG. The next step is to evaluate why this change occurs. By gaining a broader understanding of coculture competition and the environment in which they grow, we hope to develop new therapeutic strategies to prevent dental caries in the future.
Quantification of Antagonistic Hydrogen Peroxide Production Across Streptococci Species

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OBJECTIVES
Hydrogen peroxide (H2O2) is an antagonistic molecule produced by some oral bacteria and plays a significant role in interspecies interactions. During glycolysis, pyruvate oxidase (encoded by the spxB gene) catalyzes the conversion of pyruvate to acetate, generating H2O2 in the process. Different oral streptococci species are known to produce different amounts of H2O2. A broad survey between species and even isolates of the same species has not been completed to date. In this study, the amount of hydrogen peroxide produced in wild-type strains versus strains with mutations in spxB was quantified.

METHODS
Both wild-type and ΔspxB versions of Streptococcus mitis, Streptococcus oralis, Streptococcus gordonii, and Streptococcus sanguinis were measured through the amount of H2O2 produced using the Fluorometric Hydrogen Peroxide Assay Kit. Bacterial cultures were first inoculated into TYG medium with and without catalase and allowed to grow overnight before the supernatant was collected. The supernatants were added into a 96-well fluorescence assay tray. Fluorescence of H2O2 (640/680nm) and optical density (600nm) were recorded using a plate reader. The data was reported as mM of H2O2 normalized by the OD set at 600nm.

RESULTS
Varying amounts of H2O2 was recorded for each species. Streptococcus mitis displayed the most H2O2 production by an order of magnitude. The ΔspxB test presented significantly less H2O2 than the wild-type strains. These results exhibited a comparable reduction of H2O2 with the same procedure completed with catalase.

CONCLUSION
This investigation concludes that different strains of Streptococcus species produce differing levels of H2O2. Additionally, our work concludes that most of the H2O2 production is due to the spxB gene. By further characterizing antagonistic factors used by commensals against cariogenic species, we can further define strategies to prevent the emergence of odontopathogens.