IOWA

College of Dentistry
and Dental Clinics

IOWA SECTION OF THE AMERICAN ASSOCIATION FOR DENTAL RESEARCH

68th Annual Meeting

Research Awakened:
Envisioning the Future of
Oral Health Care

2021

Pamela Den Besten, DDS, Ph.D.

Our Keynote Speaker —

Pamela Den Besten is professor in the Department of Orofacial Sciences, School of Dentistry, University of California San Francisco. She directs the Center for Children's Oral Health Research, and co-directs the DDS-PhD and PhD programs in Oral and Craniofacial Sciences. Dr. Den Besten is president of the International Association for Dental Research (IADR) and past chair of the American Association for the Advancement of Science (AAAS) Section on Dentistry & Oral Health Sciences. Dr. Den Besten received the IADR Distinguished Scientist Award in Pulp Biology and Regeneration in 2009, is an AAAS honorary Fellow, has published over 125 scientific manuscripts in peer-reviewed journals and 18 book chapters. An international leader in in enamel fluorosis research, Dr. Den Besten's research focuses on tooth formation, and in particular enamel and dentin regeneration and biomineralization.

Keynote Address:

Environmental Impacts on Tooth Enamel Formation and Implications for Oral Health

Tooth enamel pathologies may result from mutation of genes involved in matrix production or environmental conditions. Bilateral hypomineralized enamel defects are generally described as enamel fluorosis. However, as fluorosis has steadily increased, the question arises as to whether this increase may be related to additional environmental stressors. This presentation will introduce data showing that in addition to fluoride or other endocrine disrupting chemicals, adverse life stressors including poverty may alter tooth and enamel formation. Such correlations suggest that tooth enamel may be a biomarker for development-related health risk factors.

Robert A. Cornell, Ph.D.

Our Featured Speaker —

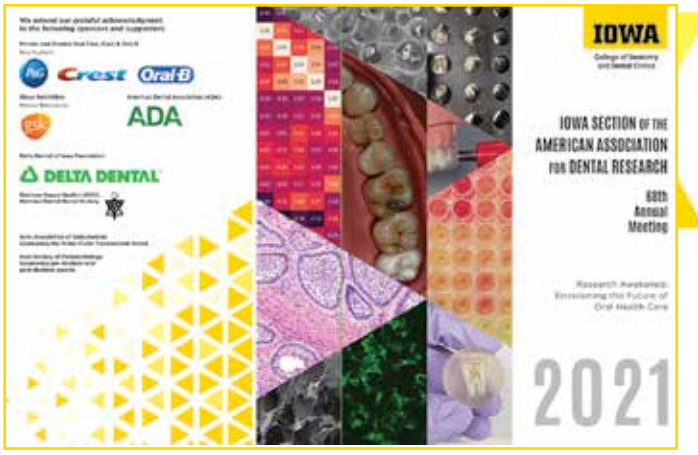
Robert A. Cornell is professor and vice chair for research in the Department of Anatomy and Cell Biology, University of Iowa. He received his BS from Stanford University, PhD in biochemistry from the University of Washington, and conducted postdoctoral research at the Institute for Neuroscience at the University of Oregon. He has been a faculty member at the University of Iowa since 2001. With funding from the NIH, his laboratory group studies gene regulatory networks governing embryonic development, using zebrafish, mouse and cell line models.

Featured Address:

Lessons on the Genetic Underpinnings of Cleft Palate From Zebrafish

Orofacial cleft is a common birth defect with a strong genetic underpinning, but only a fraction of the heritable risk for orofacial cleft has been ascribed to specific genes. To help identify these specific gene, we are using zebrafish EVL as a tractable model of human embryonic oral periderm to study a gene associated with both syndromic and non-syndromic OFC, IRF6, which encodes a transcription factor and participates in the transcriptional regulatory network governing development of the oral periderm. A recent study carried out ATAC-seq on EVL isolated from zebrafish embryos identified open-chromatin elements specific to these EVL as candidates for EVL-specific enhancers, and transcription factors binding these enhancers contribute to their transcriptional regulatory network. Additionally, our experiments help deduce the hierarchy of the transcription factors in this network. Together these experiments identify genes that harbor mutations increasing the risk for OFC, which will help sort rare variants identified in exome analyses.

Dental research images for the cover were selected from poster presentations by University of Iowa students, faculty, and staff in 2020. Thanks for these images go to Timothy Acri, John Hellstein, Jue Hu, Aditi Jain, Caroline Laroy, Jacob Miszuk, Benjamin Phan, and Daniel Soh.



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Research at our College

Research Day 2021

Bone Regeneration: Making a Fantasy a Reality

In the Harry Potter universe, Harry Potter regrew a bone simply by drinking a magic potion. Researchers at the University of Iowa College of Dentistry are working to make this fantasy a reality—not with magic but with novel tissue engineering strategies and cutting-edge science.

Dr. Hongli Sun, associate professor in the Department of Oral and Maxillofacial Surgery and the Iowa Institute for Oral Health Research, is one of several faculty members at the college leading the charge to develop novel bone regeneration strategies.

Typically, when bones or joints are seriously damaged, such as in multiple or complex fractures or in bones that are seriously compromised by age, disease, infection, or injury, the most common treatment is a bone-graft using one's own bone material. A less invasive and potentially more effective approach is to harness a body's own bodily repair processes to quickly and efficiently repair and regenerate bone.

Dr. Sun's team is researching more effective ways to use the body's own internal repair processes by tailoring a specific bone regeneration strategy to the specific cause(s) of bone damage. There are two major areas where his team is making great strides.

> ***"The drug themselves are not new and people have been using them, but we are developing a new method for controlled release of the drugs that can be delivered at a specific location."***

In the first area, emerging research uses deferoxamine, a drug that treats iron poisoning, to activate the hypoxia-induced factor-1α, which in turn promotes angiogenesis and bone regeneration. The two biggest obstacles to this line of research has been safety concerns and complicating factors, such as chronic inflammation, which are common among older individuals.

Dr. Sun's team is addressing both obstacles. Dr. Sun's team uses a small molecule, phenamil, to

Continued on page 64 — see 'Bone Regeneration' >>

Research team members (left to right) Hongli Sun, Jue Hu, Jacob Miszuk, and Zhouzhi Wang aim to develop innovative biomaterials-based therapeutic strategies for craniofacial bone regeneration.

How Can Patients Have a Satisfying Experience at the Dentist?

Although dentists often prioritize technical skill, patients generally aren't able to evaluate differences in skill and they tend to care much more about how a dentist makes them feel. This central insight was one of fourth-year dental student Hannah Klaassen's findings from her student research project, which she began four years ago and published in 2020 in the *Journal of Dental Education*.

Klaassen began the project during her first year of dental school as a part of the Dental Student Research Program, which provides opportunities for students to learn about and conduct cutting-edge research in the oral sciences.

"Communication is what makes or breaks the patient experience, and all other central areas of concern were intertwined and related to that. Patients care less about technical skills and more about how we make them feel."

The College of Dentistry had been consistently collecting open-ended patient feedback after visits, and Klaassen used these responses as the basis for her study.

"Taking patient feedback in their own words is helpful for identifying what patients notice and what aspects of patient care are positive and what isn't," Klaassen said.

After reading through the comments, Klaassen developed a coding system that allowed her to group and classify similar kinds of responses.

In particular, Klaassen noted that patients are particularly interested in (1) the emotional care they felt at an appointment, (2) the personal connections they made with staff, (3) the clear communication of expectations, and (4) clarity of communication between provider and patient and across the various departments and front desk teams at the College of Dentistry.

Klaassen with a patient in the clinic.

"Communication is what makes or breaks the patient experience, and all other central areas of concern were intertwined and related to that. Patients care less about technical skills and more about how we make them feel," Klaassen explained.

Continued on page 64 — see 'Patient Satisfaction' >>

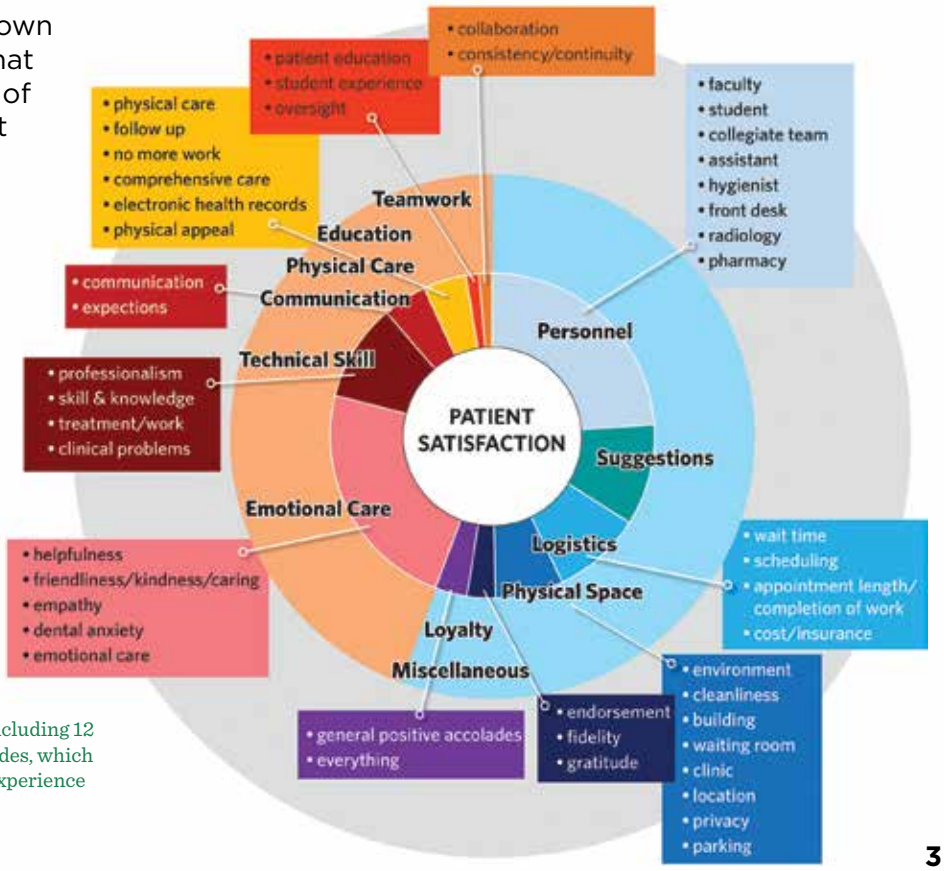
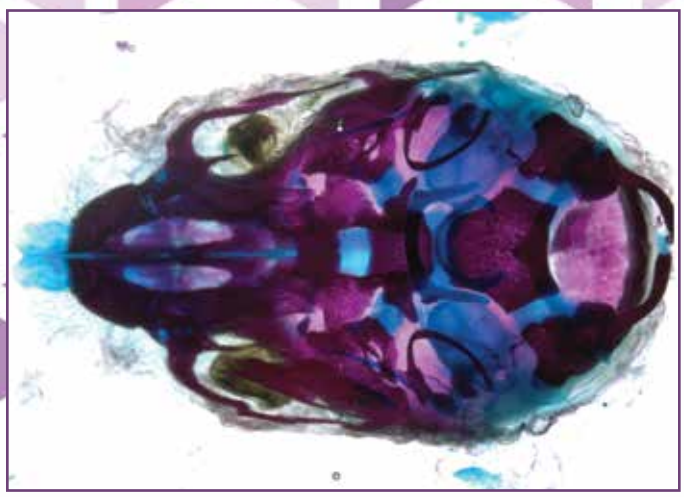
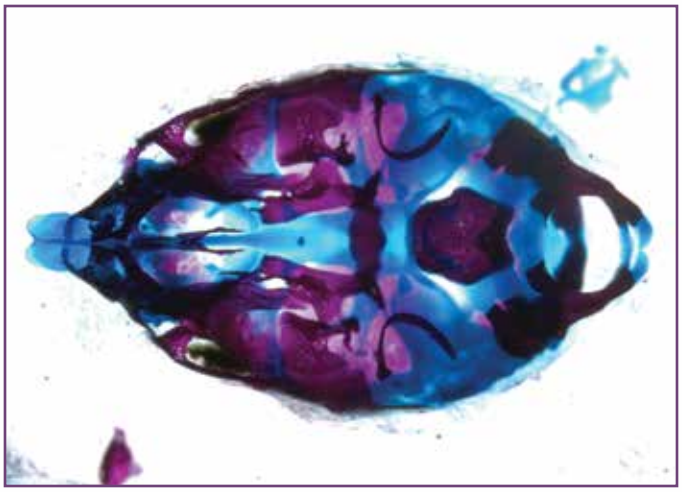


Figure: Klaassen's finalized thematic dictionary including 12 thematic categories, developed from 52 working codes, which highlighted significant aspects about the patient experience





Top: A ventral (looking up from underneath) view of a normal mouse cranial skeleton, just prior to birth, stained for bone (magenta) and cartilage (blue). The jaw has been removed.

Middle: Same as in the top panel, with the exception that the gene Memo1 has been deleted from this sample, resulting in reduced bone development and a cleft palate.

Bottom: A lateral (side) view of a normal mouse embryo mid-gestation stained for sensory neurons, including the critical trigeminal in orofacial regions. Bone, cartilage, and sensory neurons originate from a critical stem cell population, the neural crest.

Dr. Van Otterloo in his lab.

The Genetics of Bone Formation

As an expert in the genetics of embryonic development, Dr. Eric Van Otterloo has opened a new dimension for understanding craniofacial development, genetics, and bone formation.

Van Otterloo's most recent line of research began when he identified, in the mouse genome, a mutation in the gene Memo1. The mutation, which removed the Memo1 gene, affected craniofacial bone development. Up until that point, Memo1 was primarily associated with breast cancer. In this context, Memo1 was responsible for cell migration, and thus breast cancer metastasis, but Van Otterloo's discovery opened a new area of inquiry for this gene.

During embryonic development, the cartilage and bone in the head and the face develops out of a particular kind of cells called the neural crest. Along with the cranial bones and cartilage, neural crest cells contribute to several tissues important for life. Van Otterloo's discovery, using mice with mutations to the gene Memo1, revealed the MEMO1 protein has a unique role

in regulating neural crest derived craniofacial bone.

He and his team began investigating the precise mechanism behind this developmental process. First, they found that deleting Memo1 from the neural crest cells alone resulted in some of the same defects they had observed when Memo1 was removed from the entire mouse embryo. This finding suggested that Memo1 played a role directly within the neural crest cells to regulate craniofacial bone mineralization, rather than having an indirect impact on these cells.

> ***"Being able to understand the mechanism by which Memo1 operates could allow us to enhance bone formation or block bone formation to address developmental defects."***

Like the neural crest, the ectoderm also contributes to ameloblasts, the cells that deposit enamel on the outer surface of the teeth. Would MEMO1 also play a role in the mineralization process of these cells? To address this question, the Van Otterloo lab deleted Memo1 specifically from the ameloblasts. They found that deleting Memo1 from these cells resulted in severely compromised tooth enamel, again, suggesting Memo1 was somehow involved in mineralization of another tissue.

These experimental processes have helped Van Otterloo and his team investigate the precise mechanism by which Memo1 is regulating mineralization of distinct tissue types during craniofacial development. Current work in the Van Otterloo lab includes trying to determine exactly how Memo1 is controlling both of these mineralization events, and whether there are any shared feature in these mechanisms.

"Memo1 is still a little bit elusive. In breast cancer, it signals and governs cell migration, and for bone development, it regulates bone mineralization," Van Otterloo said.

"Being able to understand the mechanism by which Memo1 operates could allow us to enhance bone formation or block bone formation to address developmental defects," he added.

Van Otterloo is continuing this work with a recent, and he was recently awarded a three-year $700K grant for a project investigation the interactions between Memo1 and Runx2.

Runx2 is a transcription factor for activating genes and a master regulator for bone development. In this research project, Van Otterloo is exploring the precise relationship between Memo1 and Runx2.

"We know that Runx2 is crucial for bone development, but we don't know whether or how it is related to Memo1," Van Otterloo explained. "We will determine how central Runx2 is to the expression of Memo1 in gene regulatory networks in bone and enamel development," Van Otterloo added.

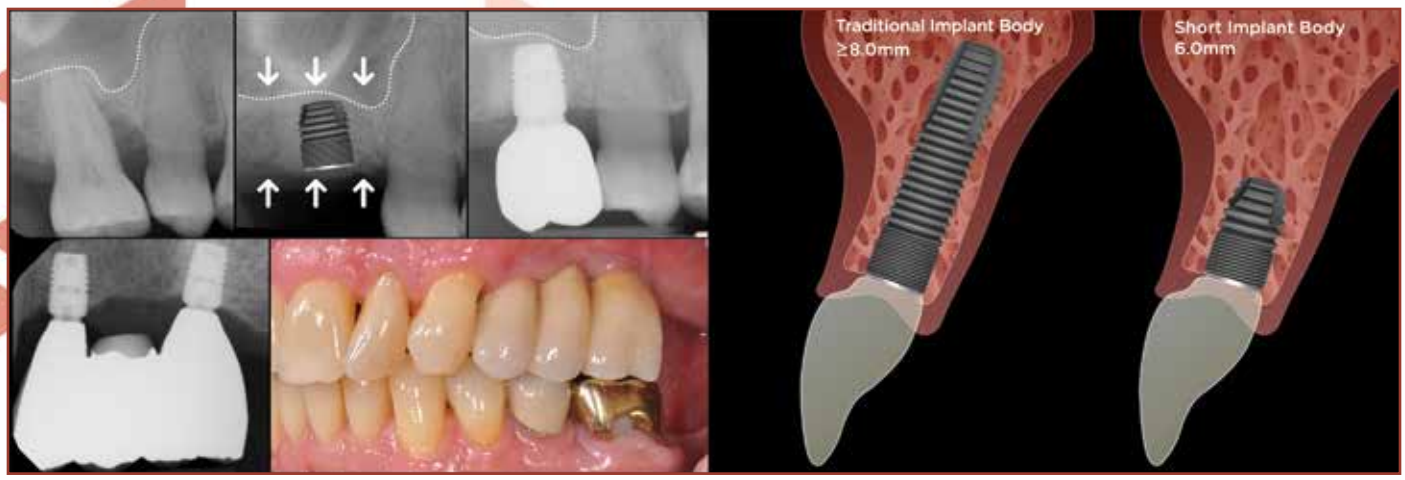
Building on Memo1's role in communicating and directing other cells, it may be the case that Memo1 plays a coordinating role setting up the cytoskeletal system, which plays an important role in the formation of bone and teeth.

This original research fits well at Iowa.

"Iowa has extensive research on cranial facial anomalies and bone regeneration harnessing genetic research," Van Otterloo said.

In particular, Van Otterloo said that Memo1 could be a good candidate for the team of researchers at Iowa looking into specific therapeutics regarding bone regeneration, and Memo1 could be used to improve specific bone regeneration strategies. Likewise, researchers at Iowa who specialize in orofacial clefting and human genetics could explore the role of Memo1 in various patient cohorts with orofacial clefting.

These studies into the genetics of embryonic bone formation are not only expanding scientific knowledge in the area, but they are also laying the basic science groundwork necessary to move from the bench to the dental chair.



Images from a recent multi-center randomized clinical trial conducted at The College of Dentistry by Dr. Barwacz comparing 5-year clinical, radiographic, and prosthetic outcomes of 6.0mm vs. 11.0mm implants.

Personalizing Implant Therapy to Improve Outcomes

The present and future direction of health care is all about delivering unique and personalized therapies. Being able to meet the exact needs of a patient, while considering their distinct attributes with a precise and measured treatment is revolutionizing the health care industry. Dentistry is no exception, and Dr. Christopher Barwacz's research is focused on improving treatment outcomes for patients receiving oral implants so that a given dental implant and its prosthetic components are customized for a given patient, rather than trying to fit the patient to a formulaic therapeutic regimen.

"Oral implantology is deeply multidisciplinary—to optimize outcomes, you need to collaborate closely with quality-oriented specialists in many different areas to ensure that the final restorative outcome meets the needs of the patient."

Although the field of oral implantology started to take off in the mid-1980s, it wasn't until this century that the field matured. It moved beyond a focus of obtaining predictable and successful results pertaining to the bone growing around and supporting an implant to a focus on personalizing and optimizing implant therapy with the goal of expanding the pool of patients who could receive implant replacement therapy without affecting treatment outcomes. To achieve such ends, a focus of research efforts was needed to investigate factors in the transition zone between an implant body and its prosthetic crown that helped contribute to success.

Dr. Barwacz, associate professor in the Department of Family Dentistry, is a leader in personalizing and optimizing implantology, and his research has moved along three main directions to support these goals.

The first direction explores the outcomes of shorter implants (6 mm) versus a traditional implant (≥11 mm).

"Historically, some patients weren't good candidates for implants without undergoing significant augmentation procedures because their anatomy made it difficult to place a traditional-length implant," Barwacz explained. "But we found that shorter implants, when planned and restored properly, had a similar long-term success rate to traditional implants, which allows us to optimize the implant length to the anatomical needs of the patient, and treat them in a more minimally-invasive fashion, thereby allowing more patients to potentially receive care."

In the second, Barwacz and his team investigated the biocompatibility and longer-term prosthetic outcomes of biomaterials used in the fabrication of patient-specific, digitally-designed and manufactured custom abutments, which anchor the prosthetic tooth of the implant to the underlying implant body. "Just because a prosthetic component is still 'in function' does not necessarily mean it is 'suc-

Dr. Barwacz was the recipient of the 2019 James H. and Hermine E. McLeran Faculty Award, which seeks to recognize excellence as an educator and commitment to patient-centered care.

cessful', when taking into account factors such as inflammation, discoloration, tissue support, and patient-reported outcomes," Barwacz said. "The nature of how the prosthetic connection between an implant and its corresponding abutment is designed, as well as the morphology of the abutment as it emerges through the mucosa can potentially have a significant influence on biological stability of the peri-implant tissues, making this an exciting area of research."

The third direction harnesses the power of digital dentistry to optimize implant therapy. With a digital rendering of the patient's teeth, mucosa, and supporting bone, the clinician can not only plan the surgery virtually, but can also design and manufacture the custom patient-specific prosthetic components a priori before the actual surgery, resulting in the capability to either immediately restore the missing tooth, or to guide healing post-surgery in a customized fashion. This leads to less morbidity, a more predictable surgery, and the potential to expedite treatment that is patient-centered with a unique treatment solution.

In each of these projects, Barwacz's approach is multidisciplinary and involves close collaboration with colleagues as well as industry partners.

"Oral implantology is deeply multidisciplinary—to optimize outcomes, you need to collaborate closely with quality-oriented specialists in many different areas to ensure that the final restorative outcome meets the needs of the patient," Barwacz said.

Through it all, Barwacz's approach is to start with the end goal in mind and work backwards starting with the patient's desired endpoint and the specifics of the implant site's biology to customize care. Incorporating multicenter and multidisciplinary clinical research collaborations to help establish evidence-based protocols that expand and improve outcomes for patients in the future is what brings Dr. Barwacz the most professional satisfaction.

Dr. Barwacz giving a seminar to predoctoral denta students on the relationship between facial and oral esthetics, and its importance to comprehensive treatment planning, which is a vital step for personalized oral healthcare.

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Dear colleagues:

Thank you for your participation in the 68th Anniversary of the University of Iowa College of Dentistry's Iowa Section of the AADR on February 16, 2021. Research is central to our mission, and that has been on full display during the pandemic as many of the research presentations will explore new areas of study related to the pandemic. Our research presenters and the event's planning committee are to be heartily commended for their hard work.

We are honored to host Dr. Pamela Den Besten ('80 DDS) as our keynote speaker. Dr. Den Besten is professor in the Department of Orofacial Sciences, the Director of the Center for Children's Oral Health Research, and the president of the IADR. As an outstanding alumna, researcher, and an international leader in our profession, she is an expert in tooth formation and regeneration and biomineralization of enamel and dentin with hundreds of peer-reviewed publications and NIH funding since 1985. She has held and continues to hold many prominent positions at her university and in the profession more broadly. We are proud to have Dr. Den Besten as an alumna and as our keynote speaker!

Over the past several years, our college has been successful in recruiting bright and talented faculty. This includes faculty with significant interests in tissue engineering, ceramics, genetics, malocclusion, health policy, and translational and clinical research. This infusion of new ideas has brought new avenues of research and mentoring opportunities across the pre-doctoral, clinical post-doctoral, and graduate programs, and it has produced a banner year in research productivity even during the midst of the pandemic. It is an exciting time for the college's future!

This day showcases the people and the spirit of discovery that have always made possible outstanding education, service, research, and patient care within our college. Thank you for being a part of this important event.

Best wishes,

David C. Johnsen, DDS, MS
Dean

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Dear fellow researchers:

The Annual Meeting of the AADR displays the wealth of expertise and research at the College of Dentistry and the Iowa Institute for Oral Health Research. During the COVID-19 pandemic, the college has had a banner year in research with a record number of funds awarded over the past 18 months and a record number of grant applications.

Our students, post-doctoral associates, residents, faculty, and staff have worked together in a multidisciplinary and collaborative environment to bring the best of basic, clinical and evidenced-based research studies to bear on pressing areas of research.

In 2020, we initiated a new seed grant program, designed to fund innovative projects from early-career investigators or established investigators who are developing a new line of research with the aim of encouraging research and generating data that will enable the awardees to be competitive for peer-reviewed national funding agencies. The college greatly appreciates the dedication of the panel who reviewed the submissions and the 11 outstanding research teams. I have no doubt that all these proposals will turn into highly competitive submissions for external funding, and I look forward to the next round of submissions.

This high level of research productivity is bearing the fruit from the college's commitment to research over the last several years, with hires of new faculty members and the continuation of the college's NIH T90/R90 training program, which has been funded for over 30 years, the support of our Biostatistics and Computational Biology faculty, and a strong and successful student research program.

This year we are honored to have Dr. Pamela Den Besten as our keynote speaker. Dr. Den Besten is a global leader in research on tooth formation and regeneration, and has been a prominent supporter of the college and its commitment to research over the years. Dr. Robert Cornell, professor of anatomy and cell biology at the University of Iowa, is our featured speaker, and he was also the chair of the seed grant review committee. The college greatly values the opportunity to hear from such distinguished academic leaders.

Warmest Regards,

Xian Jin Xie, PhD
Associate Dean for Research

IOWA

College of Dentistry
and Dental Clinics

Dear Colleagues,

On behalf of the Iowa Section of the American Association for Dental Research (AADR), we are very pleased to welcome you to our 68th Annual Meeting "Research Awakened: Envisioning the Future of Oral Health Care." This virtual event provides a forum for presenting novel research discoveries while strengthening and creating new opportunities for collaboration. We are honored to have Dr. Pamela Den Besten as our keynote speaker. Dr. Den Besten is a 1980 DDS graduate of the University of Iowa and is the current President of the International Association for Dental Research (IADR). Much of her research focuses on studying enamel and dentin formation and the oral health care of medically-compromised children. Her scientific findings have and will continue to shape the future of oral health research and treatment! We are also thrilled that our international guests from Chongqing Medical University in Chongqing, China will be joining us virtually for this meeting, furthering our collaboration!

As researchers, clinicians, and students, we are accustomed to the phenomena of not having things go as planned, and needing to pivot, whether it be at the laboratory bench, in a clinical trial, in the classroom, or treating patients. The year of 2020 brought tremendous unknowns and challenges to our research enterprise, our profession, and school. However challenging this time was, with clinic and research being suspended, social distancing, PPE, and many more changes, it was also a time of opportunity and creativity. You may not have been able to be in the building performing research, but that did not stop us. Many people wrote manuscripts, grants, or collaborated with colleagues on new and old ideas. For our clinical research enterprise, we pivoted to meeting research subjects virtually. For meeting with our colleagues, teaching classes, research discussion, and even planning the 2021 Iowa AADR meeting, we pivoted to using Zoom! The challenges of 2020 awakened in us a spirit of discovery allowing us to make novel discoveries and tremendous progress in oral health research and allowed us to grow personally and professionally.

We embrace the challenges thrown at us in 2020 and those to come in 2021 with zeal and research was awakened! We welcome you to ***Research Awakened: Envisioning the Future of Oral Health Care***, your 2021 Meeting of the Iowa Section of AADR!

Sincerely,

Brian J. Howe, DDS, MS, FICD
President, Iowa Section of the AADR
Assistant Professor
Department of Family Dentistry

Carolina Cucco, DDS, MS, PhD
Vice-President, Iowa Section of the AADR
Assistant Professor
Department of Endodontics

Sara E. Miller
Secretary/Treasurer, Iowa Section of the AADR
Research Associate/Coordinator

The six researchers from Chongqing Medical University School of Stomatology shown above will be presenting their projects virtually at the 2021 Iowa Section of the AADR Annual Meeting. The top row, left to right: Hong Chen, Yiru Fu, Nannan Huang; The bottom row, left to right: LiangJing Xin, Shuai Yuan, and Tingwei Zhang.

The University of Iowa College of Dentistry and Dental Clinics welcomes our presenters from Chongqing Medical University, School of Stomatology, Chongqing, China for the 2021 Virtual Annual Meeting of the Iowa Section of the AADR. We appreciate our joint efforts to advance the exchange of ideas, research and education, which strengthens oral health global initiatives here and abroad, as research reawakens during the pandemic.

Milestones of Achievement Between Iowa and Chongqing

- The University of Iowa College of Dentistry (UICOD) established a Memorandum of Agreement with Chongqing Medical University School of Stomatology (CMUSS) — To collaborate for the Advancement of Oral Health Research and Scholarship in Oral, Craniofacial and General Health—September 2016.
- Faculty and colleagues from CMUSS presented their research at the 2018 and 2019 Annual Meetings of the Iowa Section of the AADR. This partnership helped strengthen our commitment to the exchange of ideas, research, teaching and training opportunities for all of our faculty and students—February 2018 and February 2019.
- Faculty from the University of Iowa attended the 1st Sino-U.S.Summit Forum of Dental Hospitals for Faculty-to-Faculty Cooperative Exchange. This formal summit included presentations from UICOD and CMUSS faculty—May 2018.
- Since 2018, the UICOD and CMUSS faculty have several joint research projects and collaborations including:
  1. A joint research project on microRNA-based craniofacial bone regeneration, with Chongqing researchers performing animal experiments that demonstrated the enhanced mandibular bone regeneration using plasmid microRNA-incorporated in modified collagen plugs. Iowa researchers participating in the project came from the labs of Drs. Brad Amendt, Liu Hong and Hongli Sun.
  2. Dr. Yi Shu, D.D.S., Ph.D., is a visiting scholar from Chongqing who is conducting research in Dr. Liu Hong's lab. Dr. Shu is an assistant professor of endodontics at Chongqing Medical University.
  3. Dr. Jin Xie is advising Dr. Tao Chen on clinical research infrastructure as Chongqing Medical University School of Somatology develops its clinical research center.
- We are pleased to welcome our Chongqing collaborators to the Annual Meeting of the Iowa Section of the AADR held on February 7, 2020. We are advancing our exchange of ideas, research and education, which strengthens oral health global initiatives here and abroad.

Program

Iowa Section of the American Association for Dental Research (AADR)
68th Annual Meeting, Tuesday, February 16th, 2021

8:00 a.m.	**Welcome Address** Dr. David Johnsen
8:10 a.m.	**Featured Speaker Introduction** Dr. Carolina Cucco
8:15 a.m.	**Featured Speaker** Dr. Robert Cornell *"Lessons on the Genetic Underpinnings of Cleft Palate From Zebrafish"*
8:55 a.m.	**Keynote Speaker Introduction** Dr. Brian Howe
9:00 a.m.	**Keynote Address** Dr. Pamela Den Besten *"Environmental Impacts on Tooth Enamel Formation and Implications for Oral Health"*
9:50 a.m.	**Break**
10:00 a.m. - 12:00 p.m.	**Oral Presentations** (passcode for all sessions = "AADR2021") Oral Session 1 (https://uiowa.zoom.us/j/96798793434) Oral Session 2 (https://uiowa.zoom.us/j/94878951709) Oral Session 3 (https://uiowa.zoom.us/j/94362211853) Oral Session 4 (https://uiowa.zoom.us/j/98093645223) Oral Session 5 (https://uiowa.zoom.us/j/96081537944) Oral Session 6 (https://uiowa.zoom.us/j/94421808650) Oral Session 7 (https://uiowa.zoom.us/j/92761884079)
11:00 a.m. - 12:00 p.m.	**Short Talks** Short Talk Session 1 (https://uiowa.zoom.us/j/94841834627) Short Talk Session 2 (https://uiowa.zoom.us/j/96598712044) Short Talk Session 3 (https://uiowa.zoom.us/j/96798793434)

Note: Due to the virtual nature of our 2021 meeting, there will not be an in-person awards banquet. We will notify presenters of awards and present certificates the week following the meeting. All awardees will be highlighted in a special Iowa AADR edition of the DSB Weekly.

Presentation Assignments

Presenters are **underlined**.
Mentors are *italicized*.

Oral Session 1

https://uiowa.zoom.us/j/96798793434 passcode "AADR2021"

(b) Max Smith Pre-Doctoral Competition
(c) Max Smith Oral Health Science Graduate Competition
(e) Wefel Family Student Scholarship Pre-Doctoral Award
(f) Wefel Family Student Scholarship Post-Doctoral Award
(g) AADR Student Research Award - Pre-Doctoral
(h) AADR Student Research Award—Post-Doctoral Award
(t) Department Postdoctoral Specialty Awards: Orthodontics
(x) Department Postdoctoral Specialty Awards: Basic Science
(dd) Staff Research Award
(ee) Staff Research Award

1. b,e,g **Mary Y. Li**, J. Olotu, C.J. Buxo, P.A. Mossey, D. Anand, T. Busch, A. Alade, L.J.J. Gowans, M.A. Eshete, W.L. Adeyemo, T. Naicker, W.O. Awotoye, C. Adeleke, S. Gupta, V. Bravo, S. Huang, O. Adamson, A.M. Tora—O, C.A. Bello, M. Soto, R. Ledesma, M. Marquez, J. Cordero, L.M. Lopez-Del Valle, M. Salcedo, N. Debs, A.L. Petrin, H. Malloy, K. Elhadi, O. James, M. Ogunlewe, F. Abate, T. Hailu, I. Mohammed, P. Gravem, M. Deribew, M. Gesses, M. Hassan, J. Pape, S. Obiri-Yeboah, F. Arthur, A. Oti, P. Donkor, M.L. Marazita, S. Lachke, A.A. Adeyemo, J.C. Murray, *A. Butali*

   Candidate Gene Variant Analyses in Orofacial Clefts in Multi-Ethnic Populations

2. b,e,g **Sang R. Han**, N. Mukhopadhyay, S.M. Weinberg, M.L. Marazita, *M. Dunnwald*

   Digital Analysis of Cleft Lip Scar for Wound Healing Characterization

3. c,f,h,t **Timothy Nguyen**, M. Schotanus, *E. Van Otterloo*

   ***TFAP2*'s Regulation of Neural Crest in Craniofacial and Cardiac Development**

4. dd,ee **Aline L. Petrin**, X. Xie, E. Zeng, D. Moretti-Ferreira, *M.L. Marazita*, *J.C. Murray*, *L.M. Moreno Uribe*

   DNA Methylation in Twins Discordant for Van Der Woude Syndrome

5. c,f,h,t,x **Waheed O. Awotoye**, A. Alade, E. Zeng, C.L. Comnick, C. Pendleton, L.J.J. Gowans, M.A. Eshete, W.L. Adeyemo, T. Naicker, C. Adeleke, T. Busch, M.Y. Li, P.A. Mossey, A.L. Petrin, A.M. Oladayo, S. Kayali, J. Olotu, M. Hassan, J. Pape, P. Donkor, M.L. Marazita, A.A. Adeyemo, J. Murray, *A. Butali*

   Whole Genome Sequencing Reveals *de-novo* Mutations Associated with Orofacial Cleft

6. b,e,g **Jennifer Greif**, R.N. Alotaibi, N. Pappas, T. Crary, E. Spurgeon, C.A. Sanchez, C. Padilla, C.J. Buxo, A. Butali, C. Valencia-Ramirez, C. Restrepo Mu—Eton, R. Long, J. Murray, S. Weinberg, M.L. Marazita, *L.M. Moreno Uribe*

   Expanding on Occlusion Phenotypes in Non-Syndromic Orofacial Clefting

7. c,f,h **Abimbola M. Oladayo**, S.K. Prochaska, T. Busch, W.L. Adeyemo, L.J.J. Gowans, M.A. Eshete, W.O. Awotoye, A. Alade, A.A. Adeyemo, P.A. Mossey, A. Prince, J.C. Murray, *A. Butali*

   Provider Perspective on Returning Incidental Genetic Findings in Africa

8. [c,f,h,t] **Azeez Alade**, C. Pendleton, C.L. Comnick, W.O. Awotoye, E. Zeng, P.A. Mossey, L.J.J. Gowans, M.A. Eshete, C. Adeleke, W.L. Adeyemo, T. Naicker, T. Busch, A.M. Oladayo, A.L. Petrin, J. Olotu, M. Hassan, J. Pape, P. Donkor, P. Kitt, A. Visel, A.A. Adeyemo, J. Murray, M.L. Marazita, *A. Butali*

Rare Variants in Craniofacial Enhancer Regions and Non-Syndromic Orofacial Clefts

Oral Session 2

https://uiowa.zoom.us/j/94878951709 passcode "AADR2021"

(b) Max Smith Pre-Doctoral Competition
(c) Max Smith Oral Health Science Graduate Competition
(e) Wefel Family Student Scholarship Pre-Doctoral Award
(f) Wefel Family Student Scholarship Post-Doctoral Award
(h) AADR Student Research Award—Post-Doctoral Award
(j) James S. Wefel Pediatric Dentistry Pre-Doctoral Competition Award
(t) Department Postdoctoral Specialty Awards: Orthodontics
(x) Department Postdoctoral Specialty Awards: Basic Science
(y) Department Postdoctoral Specialty Awards: Tissue Engineering and Regeneration
(dd) Staff Research Award
(ee) Staff Research Award

9. E. Woodruff, G. Gutierrez, T. Williams, **Eric Van Otterloo**, M.J. Cohn

Tissue-Specific Roles for TFAP2A and TFAP2B in Tooth Development

10. [c,f,h,t,x] **Dan Su**, S. Eliason, F. Shao, *H. Cao*, *B.A. Amendt*

Characterization of Wolf-Hirschhorn Syndrome Candidate 1(WHSC1) in Pitx2-miR-23/24-Mediated Tooth Development

11. **UNAVAILABLE TO PRESENT**

Robert Staley, F. Qian, M. Johnson

Tooth Size-Arch Perimeter Discrepancy in Normal/Crowded Occlusions

12. [dd,ee] **Steven L. Eliason**, D. Su, H. Sun, L. Hong, K. Rice, *B.A. Amendt*

Therapeutic *miR-200a* and PMIS-*miR-200c* Delivery to Inhibit Premature Suture Closure

13. [c,f,u] **Kelly Binding**, *K. Leary*, *A. Lesch*, C.L. Comnick

Use of Protective Stabilization Devices by New Pediatric Dentists

14. [b,e,j] **Emily E. Starman**, M.P. Gomez Hernandez, A.B. Davis, F. Qian, S.M.Y. Lieberman, *K.A. Brogden*, E.A. Lanzel

Diluting Salivary Cytokine Concentrations in Children With Sjögren Syndrome

15. [x,y] **Fan Shao**, *H. Cao*

ATAC-Seq Reveal Transcriptional Regulatory Networks of Tooth Development

Oral Session 3

https://uiowa.zoom.us/j/94362211853 passcode "AADR2021"

(c) Max Smith Oral Health Science Graduate Competition
(f) Wefel Family Student Scholarship Post-Doctoral Award
(h) AADR Student Research Award—Post-Doctoral Award
(p) Department Postdoctoral Specialty Awards: Operative Dentistry
(v) Department Postdoctoral Specialty Awards: Preventive and Community Dentistry
(x) Department Postdoctoral Specialty Awards: Basic Science
(aa) International Award, Basic Science Research - Post-Doc or Faculty
(dd) Staff Research Award
(ee) Staff Research Award

16. [dd,ee] **Michaela Schotanus**, *E. Van Otterloo*

Defining a Mechanism for MEMO1 in Mineralization

17. [c,f,h,p,x] **Sundes A. Elfagih**, L.R. Jaidev Chakka, A. Alkhazaleh, C.L. Comnick, S.R. Armstrong, E.C. Teixeira, A. Guymon, X. Xie, A. Salem, *C. Vidal*

Bond Strength of an Adhesive System Containing Proanthocyanidin-Loaded Nanoparticles

18. [c,f,h,p] **Yun Jung Kim**, *J.L. Kolker*, *J.A. Banas*, E. Zeng, S.R. Armstrong, L. Marchini, E. Araujo, S. Cunha

Effect of Fluoride Topical Agents in Preventing Secondary Root Caries

19. [c,f,h,p] **Mohammadhossein Tajik**, *J.A. Banas*, *K. Shin*, S.R. Armstrong, J.L. Kolker, X. Xie

Evaluating Oral Probiotics for Inhibiting Clinical Strains of *Streptococcus mutans*

20. [aa] **Hong Chen**, L. Lei, Y. Yang, M.R. Weir, H.K. Xu, D. Yang, T. Hu

***RNC* Gene Regulates Exopolysaccharides Metabolism in *Streptococcus mutans* During Biofilm**

21. [c,f] **Maram E. Jaradat**, *J.L. Kolker*, A.I. Owais, S. Guzman-Armstrong, S. Anamali, A.J. Haes, E. Zeng, C.L. Comnick, M.J. Kanellis

Silver Diammine Fluoride Effectiveness in Arresting Initial Approximal Carious Lesions

22. [c,h,v] **Mahrukh Zafar**, *S.M. Levy*, *J.J. Warren*, C. Pendleton, J.L. Kolker, A. Gasparoni

Progression of Non-Cavitated Carious Lesions from Age 17 to 23

23. [f,x] **Miyuraj Harishchandra Hikkaduwa Withanage**, *X. Xie*, *E. Zeng*

Association Rule Mining Identifies Interactions Within Dental Caries Microbiome

Oral Session 4

https://uiowa.zoom.us/j/98093645223 passcode "AADR2021"

(b) Max Smith Pre-Doctoral Competition
(c) Max Smith Oral Health Science Graduate Competition
(e) Wefel Family Student Scholarship Pre-Doctoral Award
(f) Wefel Family Student Scholarship Post-Doctoral Award
(g) AADR Student Research Award - Pre-Doctoral
(h) AADR Student Research Award—Post-Doctoral Award
(n) Dental Specialty Award: Endodontic Michel Fuller Postdoctoral Award
(q) Department Postdoctoral Specialty Awards: Oral and Maxillofacial Pathology
(x) Department Postdoctoral Specialty Awards: Basic Science
(y) Department Postdoctoral Specialty Awards: Tissue Engineering and Regeneration

24. [b,e,g] **Jacob Lensing**, F. Fei, W. Pei, X. Song, *E.C. Teixeira*
Properties of Printed Zirconia Using Suspension-Enclosing Projection Stereolithography

25. [c,f,h,w] **Tarin Piangsuk**, *D.V. Dawson*, *T. El Kerdani*, *T. Lindquist*
The Accuracy of Post and Core Fabricated With Digital Technology

26. [c,f,h,n] *C. Cucco*, T. Krongbaramee, **Kelsie Pittel**
DPSC Functionality and Differentiation Potential After AuNP-PLL Complex Incorporation

27. [q] **Scott M. Steward-Tharp**, *J.W. Hellstein*, *N.J. Karandikar*
Genotyping an Autoimmune-Associated SIRPg SNP From Formalin-Fixed Tissues

28. [c,f,h] **Tabitha K. Peter**, C.L. Comnick, C. Pendleton, E. Zeng, *X. Xie*
The Human Oral Microbiome and Oral Cancer: a Meta-Analysis

29. [x,y] **Jacob Miszuk**, J. Hu, *H. Sun*
Biomimetic Nanofibrous 3D Scaffolds for Craniofacial Bone Repair

Oral Session 5

https://uiowa.zoom.us/j/96081537944 passcode "AADR2021"

(b) Max Smith Pre-Doctoral Competition
(c) Max Smith Oral Health Science Graduate Competition
(e) Wefel Family Student Scholarship Pre-Doctoral Award
(f) Wefel Family Student Scholarship Post-Doctoral Award
(h) AADR Student Research Award—Post-Doctoral Award
(i) Dental Specialty Award: Iowa Society for Periodontology Predoctoral Award
(o) Dental Specialty Award: Iowa Society for Periodontology Postdoctoral Awards
(q) Department Postdoctoral Specialty Awards: Oral and Maxillofacial Pathology
(w) Department Postdoctoral Specialty Awards: Prosthodontics
(x) Department Postdoctoral Specialty Awards: Basic Science
(y) Department Postdoctoral Specialty Awards: Tissue Engineering and Regeneration
(bb) International Award, Clinical Research - Student

30. [c,f,h,x,y] **Matthew T. Remy**, Y. Nagumo, B.A. Amendt, *L. Hong*

Bone Regeneration Induced by 3D-printed PCL Coated With miR-200c

31. [w,x,y] **Jue Hu**, Jacob Miszuk, *H. Sun*

Nanoclay-Mediated Osteoinductive Factors Sustained Release for Bone Tissue Engineering

32. [c,h,o] **Emilio Couso-Queiruga**, S. Stuhr, M. Tattan, L. Chambrone, *G. Avila Ortiz*

Post-Extraction Dimensional Changes: A Systematic Review and Meta-Analysis

33. [b,e,i] **Megha Puranam**, M. Tattan, C.L. Comnick, C. McBrearty, X. Xie, D.J. Caplan, *G. Avila Ortiz*, *S. Elangovan*

Surgery Start Time and Early Implant Failure: A Case-Control Study

34. [bb] **Liangjing Xing**

Perforated Sinus Applying A-PRF

35. [bb] **Nannan Huang**, Y. Li, Y. Lan, H. Zhang, J. Song, S. Yang

Predicting Implant Failure Risk With Preoperative CBCT and Deep Learning

36. [bb] **Shuai Yuan**

Two Techniques for Horizontal Bone Defects in the Anterior Maxilla

Oral Session 6

https://uiowa.zoom.us/j/94421808650 passcode "AADR2021"

(b) Max Smith Pre-Doctoral Competition
(c) Max Smith Oral Health Science Graduate Competition
(e) Wefel Family Student Scholarship Pre-Doctoral Award
(f) Wefel Family Student Scholarship Post-Doctoral Award
(h) AADR Student Research Award—Post-Doctoral Award
(i) Dental Specialty Award: Iowa Society for Periodontology Predoctoral Award
(x) Department Postdoctoral Specialty Awards: Basic Science
(y) Department Postdoctoral Specialty Awards: Tissue Engineering and Regeneration
(z) International Award, Basic Science Research - Student
(dd) Staff Research Award
(ee) Staff Research Award

37. [c,f,h,x,y] **Tadkamol Krongbaramee**, M. Zhu, *S. Eliason*, D. Su, Y. Shu, F. Qian, L. Yang, B.A. Amendt, *L. Hong*

MicroRNA-200c Alleviates Periodontitis-Related Inflammation and Bone Loss in Obese Mice

38. [dd,ee] **Jinmei Zhang**, F. Shao, H. Cao, C.L. Comnick, E. Zeng, *S. Zhang*

The Role of IFNs for Ligature-Induced Periodontitis in Mice

39. [b,e,i] **Katherine Moore**, M. Tattan, *S. Elangovan*, *G. Avila Ortiz*

Risk of Bias Impact on Root Coverage Outcomes

40. [z] **Yi Shu**, M. Zhu, J.A. Banas, *L. Hong*

Metabolites of Commensal Streptococcus gordonii Attenuate Inflammation

41. [z] **Yiru Fu**

Decellularized Plant Tissues Modified by Phase-Transitioned Lysozyme for Bone Regeneration

42. [z] **Tingwei Zhang**, M. Zhu, Z. Chen, X. Jin, J. Song

EVs From Periodontal Stem Cells: Proteomics Analysis and Biomanufacturing Optimization

43. **Erliang Zeng**, M. Hikkaduwa Withanage, X. Xie

A Novel Machine-Learning Framework Identifies Dental Caries and Periodontitis Biomarkers

Oral Session 7

https://uiowa.zoom.us/j/92761884079 passcode "AADR2021"

(b) Max Smith Pre-Doctoral Competition
(c) Max Smith Oral Health Science Graduate Competition
(e) Wefel Family Student Scholarship Pre-Doctoral Award
(f) Wefel Family Student Scholarship Post-Doctoral Award
(g) AADR Student Research Award - Pre-Doctoral
(h) AADR Student Research Award—Post-Doctoral Award
(k) Bernstein Award for Health Policy
(t) Department Postdoctoral Specialty Awards: Orthodontics
(v) Department Postdoctoral Specialty Awards: Preventive and Community Dentistry
(w) Department Postdoctoral Specialty Awards: Prosthodontics

44. [c] **Nicholas A. D'Antonio**, J. Newnum, M.J. Kanellis, B.J. Howe, *T.R. Anthony*
Effectiveness of Local Ventilation Controls at Reducing Respirable Aerosol Concentrations

45. [c,f,w] **Michelle Burson**, *T. Lindquist*, F. Qian, S. Abuhammoud, T. El Kerdani
Factors That Affect Dental Student Interest in Prosthodontics

46. [f,h,v] **Jirakate Madiloggovit**, X. Chen, L.R. Jacobson, C.L. Comnick, X. Xie
Oral Self-Care Function in Older Adults With Various Cognitive Abilities

47. [b,e,g] **Jillian Belieu**, *J.A. Banas*, F. Qian
Effects of Pregnancy Hormones on Growth of Select Dental Colonizers

48. [b,e,k] **Jamie J. Liu**, A. Ingleshwar, J.M. Sukalski, J.C. Reynolds, *S.C. McKernan*
Evaluation of U.S. Dentist Response Rates to Web-Based Surveys

49. [b,e,g] **Tanner L. Storbeck**, *F. Qian*, *C. Marek*, *D.J. Caplan*, *L. Marchini*
Factors Associated With Xerostomia Among Older Adults

Short Talk Session 1

https://uiowa.zoom.us/j/94841834627 passcode "AADR2021"

(d) P&G Competition
(e) Wefel Family Student Scholarship Pre-Doctoral Award
(g) AADR Student Research Award - Pre-Doctoral
(h) AADR Student Research Award - Post Doctoral
(i) Dental Specialty Award: Iowa Society for Periodontology Predoctoral Award
(j) James S. Wefel Pediatric Dentistry Pre-Doctoral Competition Award
(k) Bernstein Award for Health Policy
(l) ADA Table Clinics Pre-Doctoral Competition
(m) ADA Table Clinics Post-Doctoral Competition
(u) Department Postdoctoral Specialty Awards: Pediatric Dentistry
(x) Department Postdoctoral Specialty Awards: Basic Science

50. [g,l] **Bethany Doolittle**, L. Rhea, *M. Dunnwald*

Palatal Shelf Elevation Requires *Arhgap29* in Oral Epithelial Cells

51. [d,g,i] **Chinyere Adeleke**, T. Naicker, T. Busch, W.O. Awotoye, M.Y. Li, J. Olotu, M. Hassan, J. Pape, A. Alade, *A. Butali*

IRF6 Variants are Associated with South African Orofacial Clefts

52. [h,m,u] **Elizabeth Pfohl**, *P. Iben*, *F. Qian*, *M.K. Geneser*

COVID-19 and its Effect on Iowa Dental Practices: A Survey

53. [h,m,u] **Leah Barshinger**, *F. Qian*, J.J. Warren, T. Mabry, *K. Weber-Gasparoni*

Factors Associated with ECC in WIC-Enrolled Children Aged 12-36 Months

54. [d,e,g,j,l] **Emma Miller**, F. Qian, *K. Weber-Gasparoni*, D. Chi, *A. Lesch*

Fluoride Refusal by Parents of Pediatric Dental Patients

55. [d,e,g,x] *J.A. Banas*, *F. Qian*, **Thomas. J. Scroggs**, *M. Zhu*

Antagonisms Between *S. mutans* and Streptococci From Children

56. [d,e] **Abigail M. Wieland**, *J.A. Banas*

Probiotic Candidates Show Variable Antagonisms Against *Streptococcus mutans* Clinical Isolates

57. [d,e,g] *E.A. Lanzel*, *K.A. Brogden*, **Chaz D. Konrath**

Anti-Bacterial and Cytotoxicity Comparisons Across Toothpaste Formula Suspensions

58 [d,e,g,k,l] **Benjamin Phan**, E. Jeon, *K. Shin*

Objective and Subjective Noise Exposure Assessment with Dental Extraoral Suction

59. [d,e,g] **Hannah Klaassen**, *L. Marchini*, S. Ashida, C.L. Comnick, X. Xie, B. Smith, M. Tabrizi, K. Arsenault, O. Capin, A. Scully, C. Mata, A. Soto, A. Riberio, D. Prince, A. Christensen, L. Giner-Tarrida, M. Nieto, S. Leon, K. Gambetta-Tessini, M. Silva, A. Pereira, E. Carmo, F. Gonnelli, F. Carvalho, M. Santos, K. Collares, J. Bervian, R. Sarkis-Onofre, F. Goncalves, B. Bueno-Silva, A. Haddad, B. Gurgel, P. Alves, K. Shigli, S. Nayak, P. Nayak, V. Murugaboopathy, S. Pn, S. Deshpande, V. Murthy

COVID-19 Pandemic and Its Impact on Dental Students: A Multination Survey

60. **Carrie McKnight**, L. Marchini, M.K. Hill, C.L. Comnick

Infection Control Changes for Covid-19 in Iowa Dental Practices

Short Talk Session 2

https://uiowa.zoom.us/j/96598712044 passcode "AADR2021"

(a) Undergraduate Student Award
(d) P&G Competition
(e) Wefel Family Student Scholarship Pre-Doctoral Award
(g) AADR Student Research Award - Pre-Doctoral
(i) Dental Specialty Award: Iowa Society for Periodontology Predoctoral Award
(k) Bernstein Award for Health Policy
(l) ADA Table Clinics Pre-Doctoral Competition

61. [d,e,g,l] **Ryan Hemsley**, *J.A. Banas*, M. Zhu

Formation of a Dental Biofilm by Non-Mutans Low pH Streptococci

62. [d,e,i] **Trevor W. Craig**, C.L. Comnick, K. Leary, J. Hartshorn, D. Johnsen, *L. Marchini*

A Tool for Incorporating Interprofessional Perspectives into Dental Students Decision-making

63. [d,k] **Charlie A. Rupp**, *P.C. Damiano*

Assessing Access to Dental Care for Seniors in Rural Iowa

64. [d,k,i] **Luke Veenstra**, P. Barlow, K. Shigli, S. Nayak, A. Kossioni, *L. Marchini*

Preliminary Validation of Ageism Scale for Dental Students in India

65. [d,e,g,k] **Aminata Dumbuya**, C.L. Comnick, *L. Marchini*

Adults With Autism Seeking Dental Care: A Descriptive Analysis

66. [d,e,g,k,l] **Arshi Munjal**, J. Madiloggovit, *X. Chen*

Inter-Rater Reliability of a Study in Patients Receiving Palliative Care

67. [d,g,k] **Bobby L. LeWarne**, *D.J. Caplan*, *L. Marchini*, S. Sasser, C. Russell

Activities of Daily Living and Difficulty Eating Among Older Iowans

68. [d,e,k,l] **David J. Strabala**, *J.C. Reynolds*, S.C. McKernan, P.C. Damiano

Iowa Medicaid Member Preferences for Maintaining Full Dental Benefits

69. [d,e,g,k,l] **Morgan S. Scholtes**, *J.C. Reynolds*, A. Ingleshwar, S.C. McKernan, P.C. Damiano

Dentist Attitudes Toward an Annual Benefit Maximum in Iowa Medicaid

70. [d,g] **Shenghao Lu**, *M.R. McQuistan*, *F. Qian*, *S. Anamali*, *K. Leary*

Variables Associated with Changes in Students' Attitudes Post Poverty Simulation

71. [a] **Sydney K. Prochaska**, A.M. Oladayo, T. Busch, W.L. Adeyemo, L.J.J. Gowans, M.A. Eshete, W.O. Awotoye, A. Alade, A.A. Adeyemo, P.A. Mossey, A. Prince, J.C. Murray, *A. Butali*

Patient Perspective on Return of Incidental Findings in Africa

Short Talk Session 3

https://uiowa.zoom.us/j/96798793434 passcode "AADR2021"

(d) P&G Competition
(e) Wefel Family Student Scholarship Pre-Doctoral Award
(f) Wefel Family Student Scholarship Post-Doctoral Award
(g) AADR Student Research Award - Pre-Doctoral
(h) AADR Student Research Award - Post Doctoral
(i) Dental Specialty Award: Iowa Society for Periodontology Predoctoral Award
(l) ADA Table Clinics Pre-Doctoral Competition
(m) ADA Table Clinics Post-Doctoral Competition
(n) Dental Specialty Award: Endodontic Michel Fuller Postdoctoral Award
(r) Department Postdoctoral Specialty Awards: Oral and Maxillofacial Radiology

72. [h,m,n] *C. Cucco*, **Olivia Meier**

Current Endodontic Emergency Trends by Board Certified Endodontists

73. [f,h,m,n] **Sally R. Hays**, *F.B. Teixeira*

Evaluating the Accuracy of Fiber-Optic Transillumination to Detect Longitudinal Fractures

74. [h,m,n] **Lulu F. Schaefer**, *A.E. Williamson*, *F. Qian*

Survey of Concentration of Sodium Hypochlorite Used in Endodontic Treatment

75. [h,m,r] **Daniah Alhazmi**, *S. Rengasamy Venugopalan*, *T. Allareddy*

Descriptive Study of the Cervical Spine Non-Segmentation Using CBCT

76. [d,e,g,i,l] **Cyrus Mansouri**, *J. Miszuk*, *H. Sun*

Fabrication and Characterization of 3D Nanofibrous PLLA Scaffolds for Osteogenesis

77. [d,e,g,l] **Larkin P. Jacobson**, *J. Miszuk*, *H. Sun*

Functionalization of 3D Printed Poly(e-caprolactone) Scaffolds for Bone Tissue Engineering

78. [d,e,g,l] **Jonathan P. Brennan**, *D.J. Caplan*, *K. Stein*

Opioid Prescription Trends Following Third Molar Extractions

79. [f,h,m] **Carissa Comnick**, T. Peter, C. Pendleton, *E. Zeng*, *X. Xie*

P53, Alcohol, Tobacco and Oral Cancer: a Meta-Analysis

80. [d,e,i] **Teagan M. Byrnes**, S. Stuhr, A. Sidahmed, G. Avila Ortiz, X. Xie, P. Galindo-Moreno, *S.M. Ganesan*

Role of Toll-Like Receptors in Peri-Implantitis Pathogenesis

81. [d,e,g,i,l] **Sydney M. Woods**, A. Sidahmed, S. Vazana, M. Hakim, M. Petrie, M. Correia, E. Zang, H. Laroche, *S.M. Ganesan*

Subgingival Immune Signatures of Metabolic Syndrome

Abstracts

1. Candidate Gene Variant Analyses in Orofacial Clefts in Multi-Ethnic Populations

Mary Y. Li[1], J. Olotu[149], C.J. Buxo[60], P .A. Mossey[156], D. Anand[117], T. Busch[1], A. Alade[1], L.J.J. Gowans[127], M.A. Eshete[129], W.L. Adeyemo[128], T. Naicker[145], W.O. Awotoye[1], C. Adeleke[1], S. Gupta[1], V. Bravo[136], S. Huang[1], O. Adamson[139], A.M. Tora—O[60], C.A. Bello[60], M. Soto[122], R. Ledesma[136], M. Marquez[136], J. Cordero[136], L.M. Lopez-Del Valle[136], M. Salcedo[136], N. Debs[136], A.L. Petrin[1], H. Malloy[1], K. Elhadi[1], O. James[128], M. Ogunlewe[128], F. Abate[129], T. Hailu[129], I. Mohammed[129], P. Gravem[129], M. Deribew[129], M. Gesses[129], M. Hassan[1], J. Pape[1], S. Obiri-Yeboah[127], F. Arthur[127], A. Oti[127], P. Donkor[127], M.L. Marazita[59], S. Lachke[117], A.A. Adeyemo[155], J.C. Murray[1], *A. Butali*[1]

[1]University of Iowa, Iowa City, IA; [59]University of Pittsburgh, Pittsburg, PA; [60]University of Puerto Rico, San Juan, PR; [117]University of Delaware, Newark, Delaware; [122]University of Puerto Rico, San Juan, Puerto Rico; [127]Kwame Nkrumah University of Science and Technology, Kumasi, Ghana; [128]Department of Oral and Maxillofacial Surgery, University of Lagos, Akoka, Lagos, Nigeria; [129]School of Public Health, Addis Ababa University, Addis Ababa, Ethiopia; [136]Dental and Craniofacial Genomics Core, School of Dental Medicine, University of Puerto Rico, San Juan, Puerto Rico; [139]University of Lagos, Idi-Araba, Lagos; [145]University of KwaZulu-Natal, Durban, South Africa; [149]University of Port Harcourt, Port Harcourt, Nigeria; [155]National Human Genomic Research Institute, Bethesda, MD; [156]Department of Orthodontics, University of Dundee, Dundee, UK

Objective: Cleft lip with or without cleft palate (CL/P) and cleft palate only (CPO) are congenital birth defects where the upper lip and/or palate fail to fuse properly during embryonic facial development. CL/P and CPO fall under the larger category of orofacial clefts (OFCs), which affect ~1.2/1000 live births world-wide and imposes significant social and financial burdens on affected individuals and their families. The etiology of orofacial clefts is complex and likely results from a combination of genetic mutations with environmental covariates.

Methods: Recent genome wide association studies (GWAS) and whole exome sequencing (WES) for orofacial clefting identified significant genetic associations and variants in several genes. Of these genes, we investigated the role of common and rare variants in the SHH, RORA, MRPL53, ACVR1, and GDF11 genes. We sequenced these five genes in multi-ethnic CL/P and CPO samples in order to find mutations that may provide potential explanations for OFCs missing heritability.

Results: In total, 19 variants of interest were found, seven of which were in SHH, one in RORA, three in MRPL53, six in ACVR1, and two in GDF11. Types of mutations found included stop-gain, missense, synonymous, intronic, and splice site variants. Of these 19 variants, 3 novel missense variants were found, one in SHH, one in RORA, and one in GDF11. Rare and novel variants were further analyzed using in-silico predictive tools such as SIFT, Polyphen-2, Provean score, CADD, and HOPE.

Conclusion: This study provides evidence that mutations in SHH, RORA, MRPL53, ACVR1, and GDF11 may contribute to risk of OFCs in various populations.

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2. Digital Analysis of Cleft Lip Scar for Wound Healing Characterization

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Objective: Cleft lip and/or palate (CL/P) is one of the most common birth defects which results from failure of fusion of the upper lip and palate, and for which surgical repair is the only treatment option. The healing process involved following this repair includes several phases (inflammation, proliferation, and maturation), and alterations in any of them may disrupt this healing process. While the resulting scar varies between individuals, we previously reported an objective phenotypic characterization of wound healing and scarring on 100 individuals with unilateral CL/P. The objective of the current study was to replicate our previous findings and extend them to individuals with bilateral CL/P.

Methods: Digital images of 288 unilateral and 112 bilateral CL/P patients from various ethnicity were analyzed. Our digital analysis employed ImageJ software to collect morphometric (size of the scar on the philtrum and lip, size of the total philtrum and lip) and colorimetric (Red-Green-Blue color histogram data of the scars and unaffected skin) data. Moreover, we calculated the percentage of the scar in the philtrum. Morphometric data was acquired twice at 5 days interval. ANOVA test was conducted to determine significance.

Results: Interclass correlation score was greater than 0.9, indicating a high repeatability of data collection. Sex and race had no effect on the size of the scar (expressed as percentage of the philtrum area). However, the age was negatively associated with the

scar size (P = 0.045). Effects of sex, race and age on colorimetric scar profiles are currently underway.

Conclusion: Age constitutes a covariant that we will need to account for in our analyses. Globally, these studies have the potential to provide the basis for the genetic assessment associated with poor wound healing and be used as a predictive tool to surgical outcomes.

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3. *TFAP2*'s Regulation of Neural Crest in Craniofacial and Cardiac Development

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Objective: Numerous human congenital disorders present craniofacial and cardiac defects, in part, because both rely on the neural crest (NC) for their development. Mutations in the *TFAP2* gene family have been strongly associated with anomalies of the face and heart. Our objective is to elucidate the role of *TFAP2A* and *TFAP2B* (shorthanded TFAP2) in craniofacial and cardiac morphogenesis, compare transcriptional programming between these two neural crest-derived tissues, and identify how *Tfap2* expression is regulated in these structures.

Methods: (1) We collected control, *Tfap2a*, *Tfap2b*, and *Tfap2a+Tfap2b* mutant mouse embryos during embryogenesis. We leveraged the Wnt1-CRE-mediated lacZ reporter allele to mark NC in control and *Tfap2* mutant embryos. We also leveraged the mT/mG allele to fluorescently track and isolate cranial and cardiac NC for molecular profiling. (2) We identified noncoding DNA elements (enhancers) that drive cranial or cardiac *Tfap2b* expression. For these experiments we cross-referenced publicly available datasets to identify candidate enhancers of *Tfap2b* and then tested their ability in driving tissue specific expression using a zebrafish GFP reporter system.

Results: (1) First, the lacZ reporter allele revealed that *Tfap2* mutants display craniofacial and cardiac defects. Specifically, double mutants showed the most severe neural crest associated cranial and cardiac defects—including a failure of midface morphogenesis and disrupted outflow tract development, respectively. Second, the mT/mG reporter allele allowed pure isolation of cranial and cardiac neural crest cells from control embryos—verified by microscopy and molecular characterization. (2) Finally, we identified conserved noncoding elements with high predictive values for facial and/or cardiac expression. One such elements displays facial and cardiac GFP expression throughout zebrafish embryogenesis.

Conclusion: Our results provide evidence for a cooperative role of *TFAP2A* and *TFAP2B* in NC development. Comparing molecular programs regulated by *TFAP2* in various NC populations will help uncover linked pathogenesis between apparently distinct tissues.

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4. DNA Methylation in Twins Discordant for Van Der Woude Syndrome

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Objective: Van der Woude Syndrome (VWS) is an autosomal dominant disorder responsible for 2% of all syndromic orofacial clefts (OFCs). Mutations in *IRF6* account for 70% of VWS cases, while mutations in *GRHL3* account for another 5%. However, in approximately 25% of VWS cases, the causal mutation and gene remain unknown. VWS classically presents with lip pits and either cleft lip, cleft lip/palate, or cleft palate, with markedly variable expression. The phenotypic variation observed in monozygotic twins suggests that epigenetic events may influence the phenotype. We report the genome-wide DNA methylation profiling of a pair of monozygotic twins discordant for VWS, in which the affected twin has a missense mutation in the *IRF6* gene that is absent in the unaffected co-twin. Our goal is to explore epigenetic contributions to this phenotypic discordance such as DNA methylation differences, which can alter the expression of additional craniofacial genes.

Methods: We calculated delta-beta values (Δβ) to indicate differential methylation between the affected and unaffected twin to detect the regions with greater methylation differences (Δβ > 20%).

Results: We identified over 500 hypermethylated loci, including the known craniofacial genes *PRDM16* (Δβ=0.21) and *SHROOM3* (Δβ=0.22). On the other hand, 278 loci were hypomethylated, including *SPRY4* (Δβ=-0.3), which have been shown to interact with *IRF6* to regulate oral epithelial adhesion.

Conclusion: This exploratory approach paves the way to further studies on epigenetic contributions to phenotypic variability of craniofacial Mendelian disorders like VWS. As this is an ongoing project, we will also compare the VWS MZ twins data with data from 25 pairs of MZ twins discordant for nonsyndromic OFCs (average Δβ for each CpG site) to identify syndromic vs. nonsyndromic unique loci, as well as shared regions of differential methylation. Our study reinforces the importance of using Mendelian disorders to help in the discovery of etiological factors of complex disorders.

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5. Whole Genome Sequencing Reveals *de-novo* Mutations Associated with Orofacial Cleft

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Objective: Despite the successes of previous genetics studies of orofacial clefts, only about 25% heritability have been explained thus far. In order to explain the missing heritability of this defect, we used whole genome sequencing (WGS) analysis to investigate de-novo genetic variants that may explain the defect in African families. We hypothesized that variants present in affected individual but not carried by either parent explain the etiology and heritability of this birth defect.

Methods: A total of 150 African case-parent trios were involved in this study. After quality control (QC), 130 trios were analyzed for high impact *de novo* variants. We filtered for novel/rare (minor allele frequency <0.01) coding variants that are deleterious to the protein function (loss of function and missense variants). We then prioritize the pathogenic variants that play roles in craniofacial morphogenesis that may explain the birth defect. We also screened for novel pathogenic *de novo* variants in cleft candidate genes.

Results: Our *de novo* analysis identified novel loss of function variants in TTN and MINK1 genes, and missense variants in DHRS3 and TULP4. These variants are predicted to be pathogenic and deleterious to the protein structure and function. Evidently, these genes are involved in the development of the face and some have been shown to play roles in the etiology of cleft lip and palate. Additionally, we found novel variants in TP63 and SHH which are well reported orofacial cleft candidate genes.

Conclusion: WGS analysis of *de novo* variants in NSCL/P African families identified novel genes and variants in candidate genes that may explain the development of this birth defect. Our study provides additional evidence for the role of *de novo* variants in the etiology of NSCL/P. Findings from this study also shows the power of WGS analysis of trios in genetic variants discovery.

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6. Expanding on Occlusion Phenotypes in Non-Syndromic Orofacial Clefting

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Objective: Children born with orofacial clefting (OFC) often exhibit moderate or severe malocclusion, frequently attributed to the physical cleft or to sequelae from cleft repairs. To identify malocclusion features of the cleft phenotypic spectrum that are not due to the presence of an overt cleft, we compared malocclusion status between seemingly unaffected family members of individuals with OFC and controls with no personal or family history of craniofacial anomalies.

Methods: Thirty-four occlusion variables were analyzed from intraoral photos of 2,540 individuals from different ancestral backgrounds including N=894 unaffected relatives and N=1646 controls. Ancestry and relative-control comparisons were done via the Chi-square (?2) or Fisher's exact test when appropriate using the R Statistical Package, version 4.0.2 (http://www.R-project.org.).

Results: For the primary dentition, North Americans had more Class II whereas Asians and Latin Americans had more Class III relations and crowding. For the permanent dentition, Africans had more Class III and upper arch spacing, whereas North Americans had more Class II, and crowding. Asians had more anterior cross bites and lower arch spacing and Latin Americans had more negative overjet, open bites and posterior cross bites. Relatives vs. controls comparisons for the primary dentition showed non-significant trends towards more malocclusion in cases than controls. However for the permanent dentition, cases had significantly (P<0.01) more open bites, posterior cross bites, Class III relations and crowding than controls.

Conclusion: Malocclusion differences between backgrounds are consistent with previous literature supporting our results. Unaffected relatives of individuals with OFC present significantly more malocclusion than controls. The preponderance of Class III, posterior cross bites, open bites and crowding, all of

which are indicative of underdeveloped arches, mimic findings in individuals with OFC, confirming that such features belong to the OFC phenotypic spectrum and therefore may share similar genetic etiology. Our results add to our understanding of the OFC spectrum and etiology.

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7. Provider Perspective on Returning Incidental Genetic Findings in Africa

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Objective: Existing studies have shown that lack of resources and knowledge are barriers to returning genomics results. However, little is known about the level of expertise and knowledge of clinicians providing craniofacial care in Africa about genetic diseases, despite the high burden of genetic disorders.

Methods: A pilot survey was conducted by administering online questionnaires to providers across participating cleft-craniofacial clinics in Ethiopia, Ghana, and Nigeria. The 63-question survey assessed the providers' past experience with genetic testing, genetics education, and returning genetic results; provider knowledge; clinician comfort with returning results; available resources to assist with genomic findings; and potential barriers.

Results: Twelve providers completed the pilot survey. Only one had been involved in the delivery of ES or GS, two had ordered genetic testing in the past year; six agreed that IFs should be disclosed to participants, and eight were somewhat to extremely comfortable about discussing the risk factors for common disease with patients. Providers (six) also agreed that genetic test results could help the clinical management of non-cleft disease

Conclusion: The pilot survey showed that providers were aware that genetic testing could help in the clinical management of diseases. Also, providers cited the lack of knowledge about genomic medicine and lack of available resources as limitations to incorporating genetics into their practice. The validated questionnaire will be distributed from December 1, 2020, to February 28, 2021. This is the first ELSI study to document the knowledge and comfort level of cleft providers in Africa with reporting IFs (genetic and infectious) and determine the type of information necessary to assist providers with returning non-craniofacial findings in cleft-craniofacial clinics.

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8. Rare Variants in Craniofacial Enhancer Regions and Non-Syndromic Orofacial Clefts

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Objective: Orofacial clefts are the most common congenital birth defects accounting for 65% of all head and neck deformities. To date, Genome Wide Association Studies (GWAS) have identified over 60 common risk loci for non-syndromic orofacial clefts (NSOFCs). Collectively, these loci only explain 20-30% of its heritability. Interestingly, a substantial number of these loci are in the non-coding regions (enhancers) of the genome. In order to explain the "missing heritability", we investigated putative craniofacial and ectodermal enhancer elements for rare variants with probable etiological implication in the pathogenesis of NSOFCs.

Methods: Candidate craniofacial and ectodermal enhancer elements were identified from previous literatures and mouse models. A total of 58,449 regions were considered. Following filtration to include only those with more than one rare (MAF < 1%) SNP from our data. The final test datasets included 2,683 (2,610 putative ectodermal enhancer) regions, which consisted of 13,424 (13,256 in ectodermal enhancer regions) unique SNPs. Two different burden tests (combined multivariate and collapsing (CMC) test and sequence kernel association test (SKAT) were performed.

Results: We found a suggestive significant association (p = 0.009) with a putative craniofacial enhancer located within an intronic region of PRDM16 gene (Chr1:3148388-3149216). Bonferroni corrected p-value was p= 0.0007) *PRDM16* is a known cleft candidate gene and p300 ChIP-Seq data showed enhancer activity for this region, part of which overlaps with data from ATAC-Seq data in relevant craniofacial tissues. Our collaborators are currently testing the lead SNP in this region using the newer ATAC-Seq method and the result will be presented at the meeting.

Conclusion: Our findings suggest a role for rare variants within craniofacial enhancer regions in the complex etiology of NSOFCs.

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9. Tissue-Specific Roles for TFAP2A and TFAP2B in Tooth Development

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Objective: Mice possess two types of teeth that differ in their cusp patterns; incisors have one cusp and molars have multiple cusps. The patterning of these two types of teeth relies on fine-tuning of the reciprocal molecular signaling between dental epithelial and mesenchymal tissues during embryonic development. The AP-2 transcription factors, particularly Tfap2a and Tfap2b, are essential components of such epithelial-mesenchymal signaling interactions that coordinate craniofacial development in mice and other vertebrates, but little is known about their roles in the regulation of tooth development and shape.

Methods: We used a combination of methods, including targeted in situ gene expression profiling along with mouse conditional genetics to uncover if TFAP2 regulates tooth patterning.

Results: Here we demonstrate that incisors and molars differ in their temporal and spatial expression of Tfap2a and Tfap2b. At the bud stage, Tfap2a is expressed in both the epithelium and mesenchyme of the incisors and molars, but Tfap2b expression is restricted to the molar mesenchyme, only later appearing in the incisor epithelium. Tissue-specific deletions show that loss of the epithelial domain of Tfap2a and Tfap2b affects the number and spatial arrangement of the incisors, notably resulting in duplicated lower incisors. In contrast, deletion of these two genes in the mesenchymal domain has little effect on tooth development.

Conclusion: Collectively these results implicate epithelial expression of Tfap2a and Tfap2b in regulating the extent of the dental lamina associated with patterning the incisors and suggest that these genes contribute to morphological differences between anterior (incisor) and posterior (molar) teeth within the mammalian dentition.

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10. Characterization of Wolf-Hirschhorn Syndrome Candidate 1(*WHSC1*) in Pitx2-miR-23/24-Mediated Tooth Development

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Objective: Wolf-Hirschhorn syndrome (WHS) is a developmental disorder attributed to a partial deletion on the short arm of chromosome 4. WHS patients suffer from oral manifestations including cleft lip and palate (CLP), hypodontia and taurodontism. However, the causative factors and underlying mechanisms of these oral anomalies are relatively unknown. Wolf-Hirschhorn syndrome candidate 1 (*WHSC1*) is a H3K36-specific methyltransferase that is frequently deleted in WHS. This gene has been associated with craniofacial defects including CLP and defects in occipital ossification. In our study, we aim to understand the role of *WHSC1* in tooth development.

Methods: To characterize the role of *Whsc1* in tooth development, we profiled the *Whsc1* expression pattern during mouse tooth development by immunofluorescence staining (IF). To investigate the regulatory effects between *Whsc1* and *Pitx2*, we overexpressed either *Whsc1* or *Pitx2* in oral epithelial cell line LS8 and detected their expression. Then, ChIP-PCR and luciferase assays were performed to confirm the binding on the promoter regions. To determine the negative regulation of *Whsc1* by miR-23-3p and miR-24-3p, miRs were inhibited by our Plasmid-based microRNA inhibition system in LS8 cells followed by detecting the mRNA and protein level of *Whsc1*. Luciferase assays were also conducted to confirm the direct binding between miRs and *Whsc1* 3'UTR.

Results: *Whsc1* expresses from early stage of tooth development and restricts to stem cell niches in homeostatic tooth germ. *Whsc1* and *Pitx2* reciprocally activate each other's expression through chromosomal and transcriptional regulation. miR-23-3p and miR-24-3p, two miRs that regulated by *Pitx2*, directly inhibit *Whsc1*.

Conclusion: *Whsc1* expresses in the developing tooth germ and participates the *Whsc1-Pitx2-miR23/24* regulatory network in oral epithelium cells. Our observations provide new insights into the potential role of *Whsc1* in regulating tooth development and a possible causer of the dental defects in WHS.

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11. UNAVAILABLE TO PRESENT

Tooth Size-Arch Perimeter Discrepancy in Normal/Crowded Occlusions

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Objective: Evaluate potential reasons for crowding by measuring & comparing tooth sizes, arch perimeter, and arch widths in the permanent dentitions of Class1 normal occlusion (C1N) and Class1 crowded occlusion (C1C). Norms for tooth size-arch perimeter discrepancy will be determined.

Methods: Casts with ClN and C1C (ages 15-27) were obtained from the Iowa Facial Growth Study and University of Iowa Department of Orthodontics archives, respectively. Digital calipers were used to take the following measurements on the casts: (1) mesial-distal tooth widths on teeth mesial to the first molars in both arches, (2) a series of 6 arch length measurements from the mesial of right first molar to the mesial of the left first molar, the sum of which equals arch perimeter, (3) arch width at first molars, and (4) arch width at canines. A two-sample t-test was used to assess the differences between ClN and ClC or genders based on tooth width and arch length measurements (alpha=0.05).

Results: Significant differences were found between the ClN and ClC groups in the variables defined as arch perimeter minus the sum of the tooth widths in both upper and lower arches ($p<0.001$). No significant differences were found between the two groups in maxillary inter-canine widths, mandibular inter-canine widths and mandibular inter-molar widths; however, a significant difference was found between the maxillary inter-molar widths ($p=0.018$); with the widths of the ClN group significantly larger than the widths of the ClC group.

Conclusion: [1] Type1 ClC (upper and lower arches crowded) differed significantly from Class I normal occlusions: the sum of tooth widths in CIC were significantly larger than in CIN. [2] No differences were found for upper and lower inter-canine widths, and lower inter-molar widths. [3] A significant difference was found between the maxillary inter-molar widths, CIN had larger widths than the CIC group.

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12. Therapeutic *miR-200a* and PMIS-***miR-200c*** Delivery to Inhibit Premature Suture Closure

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Objective: Craniosynostosis is defined as the premature fusion of one or more cranial sutures. It is one of the most common congenital craniofacial defects occurring 1 in 2000 to 2500 live births in the United States. Bony growth occurs through differentiating mesenchymal cells at their edges, the so-called osteogenic fronts. When osteogenic fronts approximate each other, they can either fuse or form a cranial suture.

Objectives: To explore an alternate, less invasive bioregenerative strategy to rescue or prevent the osseous fusion of sutures and ultimately to ameliorate the outcome of craniosynostosis treatment.

Methods: Over expression using plasmid DNA of m*iR-200a* and inhibition of *miR-200c* (PMIS-*miR-200c*), which targets the Wnt/BMP signaling pathways will prevent ossification and suture closure. Our rationale is that by interfering with the expression of mediators in Wnt/BMP-induced osteogenic pathways we can protect the sutural osteoblasts and their progenitors from premature ossification even in Twist1 mutant mice.

Results: 1) *miR-200a* functions to inhibit calvarial bone formation; 2) *miR-200a* effectively down-regulates the expression of β-catenin, Pitx2, Zeb1/2, Jagged, Lef-1, Cyclin D2, CDH2, ITgaV1, Memo1, Smad and up-regulates Col1A2, ITGB1 and VIM, which are key factors in the signaling pathways that mediate osteogenic differentiation; 3) inhibition of *miR-200c* increases Noggin expression and reduces BMP signaling, 4) that modulating *miR-200a* and *miR-200c* expression can inhibit ossification and suture closure in mice. We use two new nanoparticle systems to deliver the *miR-200a* or PMIS-*miR-200c* to the sutures in mice.

Conclusion: Our preliminary data demonstrates that *miR-200a* or PMIS-*miR-200c* can inhibit osteogenesis and suture fusion by targeting BMP and Wnt signaling pathways, respectively. More broadly we can use this information to treat craniosynostosis patients and eliminate the invasive treatments currently used to treat this genetic defect.

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13. Use of Protective Stabilization Devices by New Pediatric Dentists

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Objective: This study assessed attitudes and use of protective stabilization devices (PSD) in pediatric dentists or residents practicing <10 years.

Methods: A 25-item survey was emailed to 4,243 active members of the American Academy of Pediatric Dentistry (AAPD). Descriptive information was obtained, and statistical analysis consisted of bivariate analysis ($p<0.05$).

Results: Response rate was 11%, 144 were in residency and 329 in practice. Sixty-five percent were female, 53.1% worked in private practice and 58.1% see >50% Medicaid in their practice. Over 98% received PSD training in residency and 83% would use PSD if available. Common situations where dentists would use PSD include sedations (57.7%), emergencies (77.8%), and patients with special health care needs (72.5%). According to bivariate analysis those still in residency and providers in the academic, corporate, or "other" type of practice, as well as those with a higher amount of patients on Medicaid (and less in private insurance) were more likely to use PSD ($p<0.001$). Practitioners that were female and in the Northcentral region were also more likely to use PSD ($p=0.02$, $p=0.004$, respectively).

Conclusion: Practitioner gender, practice setting, practice region, years in practice, and amount of Medicaid patients, are all important factors related to use of PSD.

14. Diluting Salivary Cytokine Concentrations in Children With Sjögren's Syndrome

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Objective: Identifying chemokine, cytokine, and biomarker (CCBM) profiles in saliva of children with Sjögren's Syndrome (SS) may identify those early in their disease course. Previously, we collected saliva from 11 children with SS and 17 healthy children and assessed their CCBM profiles. 7/105 CCBMs had the highest concentrations: B2M, MMP9, AMBP, S100A8, C9, A2M, and SLPI. Our objective was to assess the value of dilution on their detection.

Methods: Saliva samples were diluted 100-fold and the concentrations of 7 CCBMs were determined, in triplicate, using multiplexed fluorescent bead immunoassays. The concentrations were then corrected for the dilution factor. A non-parametric Wilcoxon rank-sum test was then used at the 0.05 and the $0.05<P<0.10$ marginal levels of significance. Normality was verified with Shapiro-Wilks' test.

Results: The concentrations of B2M, AMBP, C9, A2M, and SLPI in the saliva of children with SS were not different ($p>0.05$) than the corresponding concentrations of these same CCBMs in the saliva of the healthy study controls. MMP9 in children with SS was significantly higher than that in the control group ($p=0.036$) and S100A8 in children with SS were marginally higher than that in control group ($p=0.072$).

Conclusion: The results in this study corroborate the results in our prior study; the concentrations of B2M, MMP9, AMBP, S100A8, A2M, and SLPI were higher and the concentrations of C9 were lower, in the saliva of children with SS than in the saliva of the healthy study controls. We report that there is no benefit to diluting saliva samples prior to analysis.

Supported by: Pilot Research Award from the Sjögren's Syndrome Foundation.

15. ATAC-Seq Reveal Transcriptional Regulatory Networks of Tooth Development

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Objective: Tooth development requires precise spatiotemporally control of distinct gene-expression programs of multiple cell types. Much of this regulation is encoded by *cis*-regulatory elements. Currently, we know almost nothing about the dynamics of transcriptional regulatory networks regulating tooth initiation. Traditional ChIP-seq requires a large number of cells as input material, which make it almost impossible for studying tooth development *in vivo*. Fortunately, technology development in recent years has made it possible to perform ATAC-seq with as low as 500 cells (instead of millions). To build transcriptional regulatory networks regulating tooth initiation and tooth development, we will perform ATAC-seq on mouse tooth germ at different stages.

Methods: In mouse, the first sign of tooth initiation is formation of dental lamina at E11.5, which is followed by formation of tooth bud (E12.5-E13.5), cap stage (E14.5) and bell stage (E15.5-E18.5). We isolate mouse tooth germ at E12.5, E14.5, P0 and perform ATAC-seq on these cells to identify open accessible regions and putative enhancers. We also compared whole genome sequence of species that have teeth with species that don't have teeth (including Birds, Turtles and etc.).

Results: We applied computational methods to infer the core transcriptional regulatory networks regulating tooth initiation and tooth development based on these ATAC-seq data. We identified motifs of transcription factor family including Lhx, Dlx and Pitx were highly

enriched in ATAC-seq peaks. In addition, we found few putative *cis*-regulatory elements near *Bmp4*, *Wnt10a*, *Dlx1* and *Dlx2* that were conserved in species that have teeth but were disrupted in species without teeth.

Conclusion: The inference of transcriptional regulatory networks of tooth development could greatly advance our understanding of molecular mechanisms regulating tooth initiation and morphogenesis and ultimately lead to development of stem cell-based approaches for tooth repair and replacement.

16. Defining a Mechanism for *MEMO1* in Mineralization

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Objective: Mineralization, while well understood in the trunk skeleton, has superficial understanding in the context of the cranial skeleton. Understanding the unique cellular and molecular mechanisms driving the development and mineralization of craniodental tissues (e.g. bone and teeth) is critical to explain, prevent, and treat associated genetic disorders. Considering this, our lab has identified the protein *MEMO1*—initially found to associate with breast cancer metastasis—is critical for bone and enamel mineralization. However, *MEMO1*'s biological and molecular function in these processes is unknown.

Methods: We are using *in vivo* animal-based and *in vitro* cell culture-based models to address this knowledge gap. With our *in vivo* models, we have utilized immunofluorescence, scanning electron microscopy, µCT, single cell RNA-sequencing, and basic histological examination to define the craniodental defects upon loss of *Memo1* in the oral epithelium. With our *in vitro* models, we have utilized the LS8 oral epithelial cell line, along with CRISPR/Cas9 genome editing, Western Blot analysis, bulk RNA-sequencing and immunofluorescence to gain insight into the cellular and molecular function of *MEMO1* within oral epithelial cells.

Results: Our analysis of the *in vivo Memo1* oral epithelial mutants, relative to controls, identifies an important role for *MEMO1* in enamel development. Conditional mutants display chalky enamel associated with a significant decrease in enamel density. Compromised enamel in conditional mutants is further supported by alterations in gene and protein expression within ameloblasts and may include defects in the cytoskeleton. Supporting this observation, our oral epithelial *in vitro Memo1* loss-of-function model displays changes in cytoskeletal dynamics, including increased cellular contractility.

Conclusion: Our findings provide novel insight into how *MEMO1* contributes to mineralization, potentially deploying its breast cancer metastatic function (i.e., cytoskeletal regulation), within a novel biological setting—amelogenesis. Continued studies, using both the *in vivo* and *in vitro* tools we have developed, will further test predictions of this model. These results will provide insight into genetic diseases of mineralization, including those impacting the craniodental complex.

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EVO: University of Iowa College of Dentistry, start-up funds. University of Iowa College of Dentistry, Department of Periodontics.

17. Bond Strength of an Adhesive System Containing Proanthocyanidin-Loaded Nanoparticles

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Objective: The addition of mesoporous silica nanoparticles (MSN) into dental adhesives is a novel strategy for the sustained delivery of therapeutic compounds to the resin-dentin interface. This study assessed the immediate bonding performance of an experimental primer containing MSN loaded with proanthocyanidins (PACs) isolated from *Vitis vinifera*.

Methods: Extracted intact human molars were flattened with a carbide bur under copious air-water spray to expose mid-coronal dentin. Teeth were randomly divided according to the experimental primer formulation used for bonding (n=10): Exp [experimental primer (50% Bis-GMA, HEMA, CQ, EDMAB: 50% ethanol)], Exp + MSN-APTES [Exp containing unloaded MSN functionalized with 3-aminopropyltriethoxysilane (APTES)], Exp + MSN-APTES-PACs [Exp containing 20% of MSN loaded with PACs after functionalization], and Exp + MSN-PACs-APTES [Exp containing 20% of MSN loaded with PACs before functionalization]. MSN were loaded with PACs at 3:65 mg/mL ratio. After acid-etching with 37% phosphoric acid for 15 s, different primers were applied on wet dentin. Then, Scotchbond Multipurpose (3M™ OralCare) dental adhesive was applied according to the manufacturer's instructions, and teeth were incrementally restored with a resin composite (Filtek™ Supreme Ultra, 3M™). Four 2 x 2 mm resin-dentin beams were obtained per tooth and trimmed into cylindrical dumbbell-shaped specimens. Immediate micro-tensile bond strength was obtained and one-way ANOVA and Tukey-adjusted pairwise post-hoc tests were performed for statistical analysis (a=0.05).

Results: Exp + MSN-PACs-APTES presented statistically significant higher bond strength (33 MPa) than the other groups (all pairwise $p<0.03$). No statistically significant difference was observed among the other three primer formulations (Exp = 22 MPa, Exp + MSN-APTES = 20 MPa, and Exp + MSN-APTES-PACs =19 MPa) ($p=0.93$).

Conclusion: APTES-functionalized MSN can be successfully added to a primer for drug-delivery

purposes without compromising the bond strength to dentin. However, loading MSN with PACs prior to nanoparticle functionalization resulted in a better immediate bonding performance.

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18. Effect of Fluoride Topical Agents in Preventing Secondary Root Caries

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Objective: This study aims to determine whether the silver diamine fluoride agent effectively prevents secondary caries on the glass ionomer type of restorations compared to NaF varnish in the aging populations at high-risk for root caries.

Methods: A total of 15 molar teeth with non-carious roots were prepared for a class V cavity lesion (4x3x2 mm≥). The specimens were allocated to 9 different groups: 1) restoration with Fuji II LC®®: 2) restoration with Fuji II LC® followed by 38% SDF: 3) restoration with followed by 5% NaF varnish: 4) restoration with Equia Forte® HT: 5) restoration with Equia Forte® HT followed by a 38% SDF: 6) restoration with Equia Forte® HT followed by 5% NaF varnish: 7) restoration with Equia Forte® HT with resin coating: 8) restoration with Equia Forte® HT with resin coating followed by a 38% SDF: 9) restoration with Equia Forte® HT with resin coating followed by 5% NaF varnish. Samples were immersed in *S. mutans* and *L. casei* in MRS medium + 5% sucrose to develop a biofilm. Subsequently, the MRS medium was replenished daily and incubated at 37°C for 7 days. The samples were sectioned using a microtome and examined under the polarized light microscope. The deepest point of the lesion adjacent to the restoration of the tooth surface was measured from the images captured by the polarized light microscope. The lesion depth was assessed and measured using an analysis of variance (ANOVA) to determine if there is any significant difference in mean lesion depth among different treatment groups.

Results: The lesion depth was less in restorations with SDF and NaF than those without SDF and NaF agents.

Conclusion: The preventive agents could provide long-term antibacterial activity and potentially extend the restoration's longevity and avoid repair or replacement of restorations.

19. Evaluating Oral Probiotics for Inhibiting Clinical Strains of *Streptococcus mutans*

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Objective: To isolate probiotic strains from commercially available oral probiotics and examine their abilities to inhibit the growth of representative strains of cariogenic species and species associated with a healthy oral environment.

Methods: Bacterial strains, representing a diverse taxonomical panel, were isolated from commercially available oral probiotic products based on a Gram stain and/or polymerase chain reaction with species or strain-specific primers.

Growth antagonisms were assayed by standardizing inoculums to an optical density (OD_{600}) of 0.100 ± 0.005. Seven microliters of the probiotic strain were inoculated onto a blood agar plate and incubated overnight. Next, a suspension of identical OD was made with the test strain and 7ul was inoculated adjacent to the probiotic strain and incubated a second night. The order of plating was reversed to determine possible inhibition of the probiotic strain by the challenge strains. Areas of inhibition were calculated as percentages.

Results: Nine probiotic strains were isolated from commercial products: 5 *Streptococcus*, 3 *Lactobacillus* and 1 *Bifidobacterium*. Only *Streptococcus* strains had growth inhibitory activity with 3 strains displaying varying percentages of growth inhibition against members of the mutans streptococci. One of those, *Streptococcus rattus* JH145, inhibited all 4 clinical isolates of *S. mutans*. An identical ratio, 3 of 9 probiotic strains, showed inhibition toward health-related oral species. Only *Streptococcus oralis* K13 exclusively inhibited *S. mutans*. No growth inhibition was seen towards any of the isolated probiotic strains from the challenge bacteria.

Conclusion: There remains uncertainty regarding the mechanisms by which probiotic regimens may benefit oral health. Selective growth inhibition of oral pathogens is considered a desirable characteristic for probiotic strains. The results of this study suggest that only a small subset of marketed probiotics possess this property.

Supported by: Ralph Philips Student Research Award, Academy of Operative Dentistry.

20. *RNC* Gene Regulates Exopolysaccharides Metabolism in *Streptococcus mutans* During Biofilm

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Objective: The *rnc* gene (SMU 1514) is a post-transcriptional regulator gene and can encode ribonuclease III (RNase III). The objectives of this study were to identify the ecological role of *rnc* gene in the EPS synthesis and biofilm architecture during 24-120 hours.

Methods: *S. mutans* strain UA159 (ATCC 700610), Smurnc and Smurnc+ were used, and biofilms in 24-120 hours were established. In this study, differences of biofilm phenotypic appearance, especially the distribution of extracellular glucans were tested through various microscope observations. And the structural characteristics of exopolysaccharides (EPS) were analysed by special metabolic glycomics protocols like gel permeation chromatography and gas chromatography-mass spectrometer. In addition, the expression levels of biofilm formation-involved genes and proteins were confirmed. Furthermore, the transcriptome analysis was to examine the whole gene expression in UA159, Smurnc and Smurnc+ biofilms in 72 hours.

Results: The deletion of the *rnc* gene in *S. mutans* caused a decrease in both the formation of biofilm and the production of EPS. Throughout 24-120h biofilms, biofilms after 72h have stable and dense structure and function. And *rnc* gene regulated the synthesis of EPS during biofilm assembly and maturation. In addition, global gene expression profiling revealed that the expression levels of 310 genes were changed in the 72h Smurnc biofilm compared to UA159 biofilm, which could be clustered with the sugar PTS and ABC transporters. And the *rnc* gene mainly affects the metabolism of lactose, galactose, mannose and so on.

Conclusion: Collectively, it was confirmed that the biofilm of *S. mutans* was modified after 24h and matured at 72h. And the *rnc* gene was an important transcription factor in *S. mutans* that regulated the expression of sugar transporter genes and proteins, production of EPS and maturaton of biofilm.

21. Silver Diammine Fluoride Effectiveness in Arresting Initial Approximal Carious Lesions

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Objective: The aim of this study was to evaluate the effectiveness of Silver Diammine Fluoride (SDF) in arresting initial non-cavitated approximal carious lesion in adults utilizing three methods: pairwise comparison of radiographs, visual assessment of subtraction radiographs and histogram analysis of subtraction radiographs.

Methods: This study was a randomized, triple blinded, placebo-controlled clinical trial (ClinicalTrials.gov identifier-NCT02591147). The population consisted of adults aged 21-64 years old seeking care at the University of Iowa, College of Dentistry and Dental Clinics. Eligibility for the study included having at least one initial non-cavitated approximal posterior carious lesion (Radiologic scores RA1, RA2, or RA3 using the International Caries Classification and Management System (ICCMS) that was in contact with adjacent non-restored tooth surface. Participants were randomly assigned to one of the two study arms. One randomly selected lesion received either treatment (SDF solution) or placebo (water) designated as solutions “A” and “B”. Participants completed beverage intake and caries risk questionnaires at baseline and 12 months. The selected lesion was followed at 6 and 12 months. A bitewing radiograph was made at baseline utilizing a bite registration holder. Lesion progression was monitored radiographically through three methods: pairwise comparison of individual radiographs, visual assessment of subtraction radiographs and histogram analysis of subtraction radiographs.

Results: 54 participants were initially enrolled in the study. Forty-one participants completed the study. twenty (48.8%) were assigned to group A, while 21 (51.2%) were assigned to group B. The mean age was 32 years, ranging from 20 to 61 years. Most participants were female (65% of group A and 61% of group B), white ((84.2% of group A and 100 of group B), with a high caries risk (65% of group A and 71% of group B).

Conclusion: Preliminary findings suggest that SDF is a reasonable option to treat initial approximal lesions. Future results will provide more information on the progression of the lesions when SDF is used.

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22. Progression of Non-Cavitated Carious Lesions from Age 17 to 23

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Objective: Non-cavitated caries is the initial stage of caries which can gradually progress to cavitation if measures are not taken to halt its progression. This study reports on transitions of non-cavitated lesions (D1) at age 17 to progression, no change, or regression (reversal) at age 23.

Methods: This study involved secondary analyses of data from the Iowa Fluoride Study (IFS) that recruited a birth cohort during 1992-95 in Iowa and followed it until age 23. The study assessed the fluoride intakes of participants and associations among these intakes, dental fluorosis, and dental caries.

This prospective study assessed changes in the caries status of D1 lesions from age 17 to 23 years. All tooth surfaces were scored according to specific IFS cavitated/non-cavitated criteria at 17 and 23. These analyses focused only on non-cavitated lesions at age 17 and compared those scores to ones at age 23. The transitions were categorized into one of three outcomes: reversal (i.e., sound or arrested), unchanged (i.e., remained non-cavitated), or progression (i.e., progressed to cavitated, filled, or extracted due to caries) to assess caries progression.

Results: 278 (60%) of 464 participants at age 17 and 149 (44%) of 342 participants at age 23 had at least 1 non-cavitated carious lesion. Among those with a D1 lesion at age 17 also scored at 23(n=189), 90% had =1 regression, 29% had =1 progression, and 30% had =1 lesion with no change. Among the 1125 age 17 D1 lesions also examined at age 23, 801 (71%) regressed, 125 (11%) progressed, and 199 (18%) were unchanged.

Conclusion: Non-cavitated lesions are common and had higher rates of regression than progression or no change. Nonetheless, a large proportion progressed, suggesting that early detection and intervention are important in preventing frank cavitation.

23. Association Rule Mining Identifies Interactions Within Dental Caries Microbiome

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Objective: Inter-microbial interactions in oral microbiome are complex, govern by the taxonomic and functional compositions, and are associated with many oral diseases. Association Rule Mining (ARM) can be used to infer these interactions exhaustively. Further, it can be used to integrate heterogeneous 'omics' data to infer rules consisting of both taxonomic and functional components. The objective of the study is to design and apply ARM based computational approaches to explore complicated oral microbial interactions associated with dental caries.

Methods: For this study, we used a publicly available dataset that contains 10 samples of metagenomics data and corresponding metatranscriptomics data (BioProject Accession PRJNA396840) to identify inter-microbial interactions associated with dental caries. We used the QIIME1 pipeline to process the metagenomics dataset to obtain an Operational Taxonomic Unit (OTU) table. We then employed AfterQC, SortMeRNA, and FMAP to process the metatranscriptomics dataset to obtain a functional table. In order to apply ARM, we prepared a transaction-like dataset using the OTU table and the functional table, which was obtained by making 1000 random bootstrap draws from each sample. Each random draw consisted of an OTU and a function unit drawn from OTU table and functional table, respectively. We then applied classic apriori ARM algorithm to discover microbial interactions.

Results: Using ARM and microbiome 'omics' data, we have identified a number of interactions that are associated with dental caries. These patterns of interactions include 1) Veillonella dispar and Prevotella melaninogenica (Lift=1.408, conf=0.703), 2) Streptococcus spp. and Prevotella melaninogenica (Lift=1.394, conf=0.675), and 3) Streptococcus spp., enzyme K00656: pflD; formate C-acetyltransferase [EC:2.3.1.54] and Prevotella melaninogenica (Lift=1.394, conf=0.696).

Conclusion: The associate rule mining can identify distinct inter-microbial interactions associated with dental caries using heterogeneous microbiome 'omics' data.

24. Properties of Printed Zirconia Using Suspension-Enclosing Projection Stereolithography

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Objective: To evaluate the feasibility of using suspension-enclosing projection stereolithography (SEPS). Different from most AM processes, this technique is capable of printing overhanging shapes without the need of support structures.

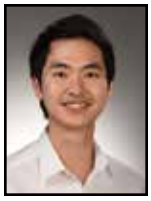
Methods: One milled zirconia material, (3M™ Lava™ Esthetic, 5%mol zirconia) commonly used to mill zirconia dental restorations, and two experimental printed zirconia groups were analyzed regarding flexural strength, hardness, and microstructure. Thirty two bar-shaped (n=16) specimens were printed using SEPS from 5% mol yttria zirconia powder (Zpex®-Tosoh, Japan) and photopolymerizable resin from an STL file, at a 70:30, and at a 75:25 ratio. Specimens were cured for 10 minutes, then debinded and sintered. Sixteen specimens, with the same measurements, were sectioned from zirconia pucks (control) and sintered using a heating, holding, and cooling cycle. A Three-point bending test was performed for all 48 specimens using a universal testing machine (Zwick) at .05mm/min crosshead speed. Knoop hardness measurements were performed using a load of 200g for 15s for both groups (N=8). The average of the two measurements was recorded.

Results: An Independent-Samples Kruskal-Wallis Test was performed to test the flexural strength among the groups. A statistically significant difference was observed for the milled group, 417.19 +/- 55.43 MPa, compared to the 70% and 75% zirconia printed groups, 70.38 +/- 28.70 and 25.31 +/- 33.17 respectively($p<0.003$). There was no difference in strength between the printed groups. The microhardness was not significantly different among groups ($p= 0.29$, One-way ANOVA).

Conclusion: SEPS showed to be a feasible technique to produce zirconia specimens. SEPS produced zirconia showed favorable microhardness property for dental application. However, SEPS specimens had significantly reduced flexural strength when compared to the control, in particular for the 75% group. Further research is necessary to optimize the debinding and sintering settings, when using SESP to print zirconia structures.

Supported by: University of Iowa College of Dentistry, Dental Student Research Program.

25. The Accuracy of Post and Core Fabricated With Digital Technology



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Objective: The purpose of this research is to compare the accuracy of post and cores created by three different fabricating methods; direct conventional, machine milling and three dimensional printing.

Methods: Thirteen extracted single root central incisors were selected. Root canal treatment and tooth preparation for crown were performed on all teeth. Post space preparation of 11 mm using prefabricated fiber post drill to standardize post space width and length. Root canal was impressed using polyvinyl siloxane impression material. The impression was then three dimensionally scanned using extraoral scanner. The scanned impressions were used to design post and cores with 3shape CAD software. The designed posts were used to print and mill post and core resin patterns. Same teeth were used to fabricate post and core with conventional technique (direct duplication of root canal with pattern resin). All posts were then scanned before invested and cast using non-precious educational alloy. The metal posts and cores were tried-in with sample teeth and adjusted until found to be clinically acceptable. The metal posts and core were scanned to perform digital measurement using Geomagic software to determine accuracy.

Results: The metal post and cores fabricated with three different techniques showed no statistical different in accuracy however, one the 3D printed post was found to be clinically unacceptable. The accuracy of 3D printed resin pattern was found to be inferior to milled resin pattern. However, dimensional stability of the 3D printed resin pattern before and after casting was found to be superior to milled resin pattern and conventional resin pattern. All three techniques showed significant volume reduction after adjustment.

Conclusion: These findings revealed that digitally fabricated post and core has the same degree of accuracy as the gold standard direct conventional post and core fabrication method.

26. DPSC Functionality and Differentiation Potential After AuNP-PLL Complex Incorporation

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Objective: As we strive for clinically translatable stem cell therapies in regenerative endodontics, the need for imaging modalities, including micro-CT, that can assess three-dimensional interactions between dental stem cells (DPSCs) and scaffolds is evident. The uptake of gold nanoparticles complexed with Poly L-lysine (AuNP-PLL) into DPSCs allows for high contrast micro-CT imaging without impacting cell vitality or proliferation.

Methods: We will assess the impact of AuNP-PLL complex-loading on DPSC odontoblastic differentiation potential and mineralization capacity using alkaline phosphatase activity (ALP), qRT-PCR, and alizarin red staining. Loaded or non-loaded (control) DPSCs are induced by odontogenic media, then evaluated for ALP activity, analyzed for odontoblast gene expression (DSPP and DMP-1), and stained for mineralized nodule formation, after 7, 14, and 21 days respectively.

Results: In preliminary experiments, cells induced by odontogenic media were statistically higher for both ALP and nodule formation compared to non-induced cells, with no significant difference between loaded and non-loaded cells. Similarly, qRT-PCR demonstrates loaded cells and non-loaded cells to have similar levels of DSPP and DMP-1.

Conclusion: With further investigation, we expect to conclude that AuNP-PLL complex-loaded DPSCs retain their differentiation potential and mineralization capacity. We further recommend the use of contrasting materials, such as AuNP, combined with practical imaging modalities like micro-CT, as a viable way to analyze dental mesenchymal cells in three-dimenisons.

Supported by: American Association of Endodontists Foundation.

27. Genotyping an Autoimmune-Associated SIRPg SNP From Formalin-Fixed Tissues

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Objective: T-cells play critical roles in many autoimmune conditions, such as type I diabetes mellitus (T1D). They are also thought to play a significant role in many immune-mediated disorders affecting the oral soft tissues: lichen planus, graft vs. host disease, Sjogren syndrome. T-cells exert their functions via direct recognition through molecules expressed on the cell surface and secretion of factors that drive or suppress inflammatory responses locally. Signal regulatory protein gamma (SIRPγ) is an immunomodulatory protein that is uniquely expressed on the cell surface of human T-cells. Our laboratory has shown that a T1D-linked genetic variant of the gene for SIRPγ (rs2281808) correlates with reduced expression of SIRPγ on the T-cell surface and that T-cells with less SIRPγ surface expression produce more inflammatory molecules. We hypothesize that single nucleotide changes within the gene for SIRPγ can lead to a predisposition for the development of immune-mediated pathosis. Our objective for this study was to assess the feasibility of genotyping individuals at single nucleotide polymorphism rs2281808 from DNA extracted from formalin-fixed paraffin-embedded tissue samples.

Methods: Archived, de-identified formalin-fixed paraffin-embedded tissue blocks were used in this study. Three 10-um thick sections per sample were deparaffinized with subsequent genomic DNA extraction using the QIAampÆ DNA FFPE Tissue Kit and Deparaffinization Solution. DNA was quantitated using UV spectroscopy at 260 nm. Allelic discrimination PCR for rs2281808 genotyping was done using a TaqMan assay and probes.

Results: Allelic discrimination PCR for rs2281808 was successful in 70% (14/20) of specimens tested.

Conclusion: This pilot study supports the feasibility of our methodology, however further studies are necessary to assess the accuracy of the genotyping results obtained via this method.

Supported by: NIH NIDCR T90.

28. The Human Oral Microbiome and Oral Cancer: a Meta-Analysis

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Objective: Contemporary research on oral squamous cell carcinoma (OSCC) includes a focus on the relationship between oral cancer and the oral microbiome. The aim of our project is to make quantitative and qualitative generalizations about oral cancer and the human oral microbiome through systematic review of the literature and meta-analysis.

Methods: We begin with a collection of 138 papers from the PubMed database, which we evaluate using 4 sets of criteria. A total of eleven papers satisfy all of these criteria. These papers are case control study designs with human patients, and they share the objective of differentiating the microbiome of tissues with OSCC with that of healthy tissue. Using relative abundance (RA) data, random effects mixed models (REMMs) are designed with RA as the outcome, case/control status as the fixed effect component, inverse sample sizes as the weights, and study as the random effect component. We report 95% confidence intervals for the fixed effect components.

Results: We find across 6 of the studies in this analysis that the *Fusobacterium* is enriched among OSCC cases. Regarding contemporary techniques for assessing diversity of the oral microbiome, 16srRNA marker gene based analyses are dominant in the papers we review. However, a lack of uniformity between studies regarding methods for reporting results poses a notable limitation for aggregating data. The REMMs give confidence intervals which indicate a potential change in oral microbiome composition.

Conclusion: The confidence intervals for the REMM fixed effects suggest that in OSCC cases, genera *Actinomyces*, *Citrobacter*, *Fusobacterium*, and *Veillonella* may be enriched while genera *Granulicatella*, *Haemophilus*, and *Neisseria* may be diminished. These results indicate that the relationship between the oral microbiome and OSCC merits further investigation.

29. Biomimetic Nanofibrous 3D Scaffolds for Craniofacial Bone Repair

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Objective: Repair and restoration of critical-sized bone defects are a significant clinical challenge due to numerous factors including but not limited to a lengthy healing period and multifaceted growth factor environment. Craniofacial bone in particular presents unique additional challenges due to the proximity to several vital organs and irregular geometry of cranial bones. Biomimetic scaffolds seeking to facilitate endogenous bone regeneration are a useful tool for repair of critical sized defects, due to their ability to mimic the native bone morphology and chemical environment. A few notable fabrication techniques for 3D nanofibrous biomimetic materials have rose to prominence over the last several decades, each of which provide unique benefits to assist in facilitation of critical-sized defect repair. Two of the more prominent methods, namely thermally-induced phase separation (TIPS) and electrospinning, will be highlighted in their genesis and subsequent development over the past years, focusing on our lab's innovative new approaches to each technique.

Methods: 3D electrospun scaffolds polycaprolactone (PCL) were generated via the thermally-induced self-agglomeration (TISA) technique, where individual nanofibers self-assembled into a 3D structure. TISA scaffolds were used neat in *in vitro* and *in vivo* mouse experiments, and further modified via several avenues, including multiple-polymer blends, functionalization with synthetic apatites, and combined with small molecules for bioactive factor release. TIPS scaffolds were synthesized with porogen (TIPS&P), and further modified with drug-binding peptides or synthetic nanoclay for improved bioactive factor release. Additionally, a 'one pot' synthesis technique was also explored without use of porogen.

Results: The highlighted synthesis techniques demonstrated significantly improved stem cell osteogenic differentiation and new bone formation in *in vivo* mouse cranial defect model.

Conclusion: Overall, the numerous modifications and functionalizations demonstrate significant promise for nanofibrous scaffold techniques in craniofacial bone regeneration for the near future.

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30. Bone Regeneration Induced by 3D-printed PCL Coated With *miR-200c*

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Objective: Tissue-engineered (TE) alternatives are essential to overcome the deficiencies of natural bone grafts; however, inefficient osteoinductive agents and inadequate scaffold fabrication methods have prevented the clinical translation of TE synthetic grafts. The design of 3D-printed constructs that prolong and sustain the release of potent osteoinductive agents, such as *microRNA-200c* (*miR-200c*), may effectively overcome these limitations to enhance bone regeneration and impact the clinical capabilities of TE synthetic bone grafts.

Objectives: The aim of our study is to develop a 3D-printed construct that prolongs and sustains the release of osteoinductive *miR-200c* in order to create a therapeutic and clinically-translatable synthetic bone graft to restore large bone defects.

Methods: Poly(caprolactone) (PCL) scaffolds were 3D-printed using fused deposition modeling. PCL scaffolds were coated with gelatin and loaded with different concentrations of plasmid DNA encoding *miR-200c* or empty vector. Bone regeneration induced by the gelatin-coated, miR-incorporated constructs was evaluated *in vitro* and *in vivo*. Scaffold coating/topography was characterized via SEM. *miR-200c* release from coated constructs was measured *in vitro* using longitudinal studies. Furthermore, human bone marrow mesenchymal stem cells (hBMSCs) were seeded onto gelatin/*miR-200c* constructs and osteogenic differentiation was quantified via qRT-PCR. *In vivo* bone regeneration was assessed after 6 weeks of scaffold implantation into critical-sized rat calvarial defects using microCT and histology.

Results: Gelatin-coated scaffolds demonstrated sustained release profiles for *miR-200c in vitro* compared to control scaffolds. Osteogenic markers were up-regulated for gelatin/*miR-200c* constructs in comparison to control samples. MicroCT and histological staining showed enhanced bone regeneration *in vivo* via gelatin/*miR-200c* constructs compared to control implants.

Conclusion: PCL scaffolds coated with *miR-200c*-incorporated gelatin increased the transfection efficiency of *miR-200c*, which lead to increased osteogenic differentiation and bone formation. Sustained release of *miR-200c* from gelatin coatings allowed for the prolonged regenerative signaling of osteoinductive *miR-200c*, which effectively enhanced bone regeneration in critical-sized bone defects.

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31. Nanoclay-Mediated Osteoinductive Factors Sustained Release for Bone Tissue Engineering

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Objective: It has been a significant technical challenge to sustain release of bioactive molecules using a facile method in a physiological/mild condition. Nanoclay (Nanosilicates, NS) shows great promise for drug delivery *in vitro*, while its potential mechanism for *in vivo* bone regeneration has barely been defined.

Methods: In this study, we explored the binding/drug release capacity of NS for osteoinductive factors (e.g., BMP2 and phenamil) and followed their effects on both osteoblastic differentiation and bone formation. *In vitro* and *in vivo* studies were carried out on NS binding to small molecules (phenamil) and macromolecule (BMP2), respectively. 3D gelatin nanofibrous scaffolds (GF) were prepared through a thermally induced phase separation method together with particle leaching technique (TIPS&P). Either BMP2 alone, NS alone or NS binding BMP2 composite (NS/BMP2) were incorporated into GF scaffolds.

Results: Our data revealed that NS had a strong binding ability to both molecules, which contributed to the controlled/sustained release of these drugs *in vitro* and *in vivo*. *In vitro* release of phenamil from NS/phenamil collagen gel showed markedly lower burst release and a prolonged release period up to 35 days compared to the phenamil alone sample, which was nearly completely released in 3 days. *In vivo* study shows that the GF-NS/BMP2 scaffolds demonstrated significantly stronger ability to promote new bone formation in a cranial bone defect mice model at low-dose BMP2, while BMP2 alone at same dose can barely repair the defects. *In vivo* experiments for phenamil/NS will be completed soon.

Conclusion: Our studies suggest nanoclay-mediated sustained drug release is an innovative and effective approach for bone tissue engineering.

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32. Post-Extraction Dimensional Changes: A Systematic Review and Meta-Analysis

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Objective: The main goal of dental therapy is to enhance and maintain the general health and well-being of patients. Dental extraction is indicated when teeth cannot be maintained in a status compatible with adequate esthetics, function, health, or for strategic reasons. Beyond its potential impact in quality of life, tooth extraction causes a local physiologic disruption that results in an initial inflammatory response and, subsequently, a variable degree of alveolar ridge atrophy. Furthermore, predicting the extent and magnitude of post-extraction dimensional changes in function of specific patient and site characteristics is particularly important to make judicious clinical decisions when tooth replacement therapy is planned. The aim of the study was to analyze evidence pertaining to post-extraction dimensional changes of the alveolar ridge after unassisted socket healing.

Methods: A literature search to identify studies that fulfilled the eligibility criteria was conducted. Qualitative and random effects meta-analyses were performed if at least two studies with comparable features and variables reported the same outcome of interest.

Results: Twenty-eight articles were selected, of which 20 could be utilized for the conduction of quantitative analyses by method of assessment (i.e. clinical vs

radiographic measurements) and location (i.e. non-molar vs molar sites). Pooled estimates revealed that mean horizontal, vertical mid-facial and mid-lingual ridge reduction assessed clinically in non-molar sites was 2.73mm (95% CI 2.36-3.11), 1.71mm (95% CI 1.30-2.12) and 1.44mm (95% CI 0.78-2.10), respectively. Mean horizontal, vertical mid-facial and mid-lingual ridge reduction assessed radiographically in non-molar sites was 2.54mm (95% CI 1.97-3.11), 1.65mm (95% CI 0.42-2.88) and 0.87mm (95% CI 0.36-1.38), respectively. Mean horizontal, vertical mid- facial and mid-lingual ridge reduction assessed radiographically in molar sites was 3.61mm (95% CI 3.24- 3.98), 1.46mm (95% CI 0.73-2.20) and 1.20mm (95% CI 0.56-1.83), respectively.

Conclusion: A variable amount of alveolar bone resorption occurs after unassisted socket healing depending on tooth type.

Supported by: University of Iowa College of Dentistry, Department of Periodontics, Graduate Student Research Fund.

33. Surgery Start Time and Early Implant Failure: A Case-Control Study

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Objective: To evaluate the influence of surgery start time (SST) and other patient- and therapy-related variables on the risk for early implant failure (EIF) in an academic setting.

Methods: Data were extracted from the electronic health records of 72 patients who had at least one EIF and 140 age- and gender-matched, randomly selected, non-EIF controls. Bivariate and multivariate analyses were performed to identify relevant associations between EIF and different variables, such as SST.

Results: Afternoon implant placement showed a slight, albeit non-significant increased risk for EIF (HR: 1.77, 95% CI: 0.88—3.54; p=0.107). Other factors that were associated with a significantly increased risk for EIF in a multivariable model were male gender (HR: 2.06, 95% CI: 1.11—3.81; p=0.021), regular use of NSAIDs (HR: 2.1, 95% CI: 1.13—3.88; p=0.018), simultaneous bone grafting (HR: 2.95, 95% CI: 1.44—6.05; p=0.003), intra-operative complications (HR: 6.32, 95% CI: 2.43—16.41; p<0.001), and placement with sedation (HR: 7.56, 95% CI: 3.81—15.01; p<0.001).

Conclusion: While SST did not influence the occurrence of EIF in our cohort, other variables, such as gender, simultaneous bone grafting, intra-operative complications and implant placement with sedation were associated with an increased risk for this adverse event.

Supported by: University of Iowa College of Dentistry, Dental Student Research Program.

34. Perforated Sinus Applying A-PRF

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Objective: To compare the effect of advanced platelet-rich fibrin (A-PRF) and collagen membrane (CM) on a perforated SM with simultaneous bone grafting in a maxillary sinus elevation model.

Methods: After perforation of the SM was established, 24 animals were randomly divided into two groups: (i) group CM: CM and deproteinized bovine bone mineral (DBBM) (n = 12), (ii) group A-PRF: A-PRF and DBBM (n = 12). Radiographic and histological evaluations were performed at 1 and 4 weeks post-operation.

Results: At 1 week, an intact SM was found in group A-PRF. At each time point, the number of inflammatory cells at the perforated site was higher in group CM, and the area of new osteoid formation was significantly greater in group A-PRF ($p < 0.0001$). At 4 weeks, the osteogenic pattern was shown as from the periphery to the center of the sinus cavity in group A-PRF.

Conclusion: The higher elasticity, matching degradability, and plentiful growth factors of A-PRF resulted in a fully repaired SM, which later ensured the two osteogenic sources from the SM to generate significant new bone formation. Thus, A-PRF can be considered to be a useful bioactive tissue-healing biomaterial for SM perforation with simultaneous bone grafting.

35. Predicting Implant Failure Risk With Preoperative CBCT and Deep Learning

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Objective: Preoperative evaluation of the jaw condition in the implant area is important for the prognosis of implant surgery and postoperative restoration.

The aim of this study was to develop a deep learning (DL) model based on preoperative maxillofacial CBCT to predict the risk of implant failure within five years.

Methods: A total of 654 patients with 740 implants were screened from the electronic medical record (EMR) at the Stomatological Hospital Affiliated to Chongqing Medical University from January 2012 to December 2019 (Ethical Review Board at Chongqing Medical University, approval 2019073). Three hundred and seventy implants were lost from the oral cavity within five years, and these were defined as high risk group and 370 implants kept stable and functional after five years, these were defined as the low risk group . Preoperative CBCT of these implants were retrieved,

located to implant area and segmented into 2D slices at a 0.4mm thickness, generating 14160 images. Generated images and their group labels were fed to an untrained DL model with Inceptionv3 as the model base and a full-connective layer linked to a sigmoid-activated single neuron layer. The training process was implemented by TensorFlow and Keras with batch size of 32, epochs of 1,000, learning rate of 1*10-5 and Adam optimizer. Ten-fold cross-validation was used to evaluate model robustness. Mean accuracy, sensitivity (recall), specificity, precision, F1-score and the area under the receiver operating characteristic curve (AUC) were the final performance metrics.

Results: The mean accuracy, sensitivity (recall), specificity, precision, F1-score and AUC were 0.763±0.031 (mean±SD), 0.817±0.058, 0.700±0.075, 0.735±0.048, 0.772±0.030 and 0.855±0.039 respectively.

Conclusion: Our preliminary DL model can predict the risk of long-term (5 years) implant failure in a limited, single-center sample group, which opens a new window to artificial intelligence integrated dentistry and gives insights into further implant investigations and practices.

36. Two Techniques for Horizontal Bone Defects in the Anterior Maxilla

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Objective: A novel approach named as "*in situ* bone ring technique" was introduced and compared with the tent-pole technique to evaluate their horizontal bone gain, resorption and patients' postoperative perception.

Methods: A total of 30 patients were included in this retrospective cohort study. All patients required horizontal bone augmentation at anterior site. Accordingly, quantitative and qualitative analyses were conduct radiographically and histologically between *in situ* bone ring (ring group) and tent-pole technique (tent group). Moreover, the visual analog scale (VAS) was applied to assess the patients' perception towards both treatments.

Results: Cone-beam computed tomography (CBCT) results showed great significant difference regarding horizontal bone width at 0mm and 3mm from alveolar ridge crest between two groups (P<0.05). On the basis of histological outcomes, favorable bony fusion was shown 6-month postoperatively in ring group. The VAS ratings for pain and swelling reflected similar results between two groups.

Conclusion: *In situ* bone ring technique evidently increased and maintained horizontal bone mass at the alveolar ridge crest compared to tent-pole technique, which might be favorable for implant rehabilitation in anterior area. Meanwhile, no further discomfort was caused according to VAS scoring between two groups.

37. MicroRNA-200c Alleviates Periodontitis-Related Inflammation and Bone Loss in Obese Mice

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Objective: To understand molecular roles of microRNA (*miR*)-*200c* in the pathogenesis of periodontitis in obese subjects (PiOS) and explore the effectiveness of plasmid DNA encoding *miR-200c* as a therapeutic tool in treating PiOS.

Methods: Endogenous *miR-200c* and *IL-6/8* in gingiva, white adipose tissues (WAT), and blood plasma were quantitated in mice with diet-induced obesity (DIO). These parameters and periodontal bone loss were also measured in the mice with periodontitis induced by injection of *P. gingivalis* lipopolysaccharides (LPS) into palatal gingiva. The protective function of *miR-200c* on inflammation, alveolar bone loss, and glucose tolerance were measured after plasmid encoding *miR-200c* injected into the inflamed gingiva.

Results: *miR-200c* was significantly reduced in gingiva and WAT in DIO mice, while the *IL-6* in gingival tissue and blood plasma were increased. Local injection of Pg-LPS at interdental gingiva at maxilla of DIO mice effectively reduced *miR-200c* in the gingiva, induced periodontal inflammation associated with systemic elevation of *IL-6* and impaired glucose tolerance. The inhibitory function of Pg-LPS and *IL-6* on *miR-200c* and *Zeb1* was confirmed *in vitro*, and the monoclonal antibody of *IL-6* can counteract the function of Pg-LPS. Interestingly, local injection of naked plasmid DNA encoding *miR-200c* at gingival tissues effectively rescued *miR-200c* downregulation, protected periodontal and systemic inflammation, and alleviated the impaired glucose metabolism in obese mice with LPS-induced periodontitis. We also identified that *miR-200c* injection effectively increased circulating exosomal *miR-200c* which suppressed proinflammatory cytokines and adipogenesis in adipocytes.

Conclusion: These data indicated that that the reduced *miR-200c* by Pg-LPS and *IL-6* in periodontitis and obesity might lead to an imbalance of proinflammatory cytokines and exacerbate inflammatory responses in the pathogenesis of PiOS, and upregulation of *miR-200c* in gingiva would serve as a potential therapeutic approach for PiOS by ameliorating periodontal and systemic inflammation and improving obese metabolisms.

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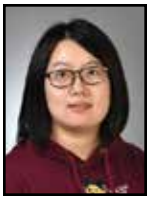
38. The Role of IFNs for Ligature-Induced Periodontitis in Mice



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Objective: Through a mediator association analysis, we identified that interferon-β, a signature Type I interferon (IFN) member, was significantly associated with severe periodontitis and tooth loss clinical phenotypes. Therefore, the objective of this study is to assess the role of IFN-β in a ligature-induced periodontal model and the underlying mechanisms of IFN-β mediated periodontitis.

Methods: Periodontal bone loss was induced in Ifnar1-/- mice, in which Type I interferon signaling is completely disrupted, and wild type mice through a ligature-enabled plaque accumulation model and quantified by microCT for bone loss. Gingival RNA was extracted for sequencing analysis. Single-cell suspension was prepared in gingiva where the ligature was placed and immune cell populations were analyzed by flow cytometry. To investigate the effect of IFN-β on osteoclast differentiation, we isolated bone marrow derived monocytes (BMDMs) from both Ifnar1-/- and WT mice and compared the osteoclast differentiation in the presence or absence of IFN-β through TRAP staining.

Results: Ifnar1-/- mice exhibited a significant bone loss as compared to WT mice (p= 0.037). Gene ontology (GO) analysis revealed that transcripts related to inflammatory responses (86 genes were down-regulated and 13 genes were up-regulated) were significantly enriched in Ifnar1-/- gingiva in comparison to WT mice. The transcription of several neutrophil-recruiting molecules was significantly upregulated in the gingiva of Ifnar1-/- in comparison to WT mice. Significantly more IL-17+ immune cells (CD45+IL-17ROR?d+) and approximately 25% more neutrophils (CD45+CD11b+F4/80-Ly6G+) presented in Ifnar1-/- gingiva than WT gingiva. While osteoclast differentiation induced by RANKL in Ifnar1-/- BMDMs non-significantly increased when compared to WT BMDMs, murine IFN-β dramatically inhibited osteoclastogenesis from BMDMs stimulated by RANKL in WT mice ($p<0.05$).

Conclusion: IFN-β pathway plays a protective role in the ligature-induced alveolar bone loss in mice by dampening local neutrophil and IL-17+ immune cell recruitment. Moreover, IFN-β can maintain bone homeostasis through inhibiting osteoclast differentiation.

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39. Risk of Bias Impact on Root Coverage Outcomes

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Objective: To assess the effect of risk of bias on relevant outcomes reported in randomized controlled trials (RCT) evaluating the efficacy of the coronally advanced flap combined with a subepithelial connective tissue graft (CAF+CTG) to correct gingival recession defects.

Methods: RCTs that involved the use of a CAF+CTG bilaminar technique were selected. The following data was extracted: mean root coverage (MRC), complete root coverage (CRC), whether conflict of interest was addressed, adequacy of random sequence generation, allocation concealment and blinding of outcome assessment. Trials were categorized into four groups according to different time periods: pre-CONSORT (before 1996), CONSORT (1997 to 2001), CONSORT 2001 (2002 to 2010) and CONSORT 2010 (2011 to 2019). Differences between group means were assessed using statistical analyses.

Results: The search yielded a total of 47 RCTs published between 1993 and 2019 that met the inclusion criteria. A trend towards lower ROB over time in the selected RCTs was observed. However, differences in MRC and CRC with respect to the degree ROB of included trials were not significant.

Conclusion: Degree of ROB did not influence MRC and CRC reported in the RCTs included in this investigation. This finding suggests that the observed improvement of clinical outcomes over time should be attributed to other factors, such as refinement of surgical techniques.

Supported by: University of Iowa College of Dentistry, Dental Student Research Program.

40. Metabolites of Commensal *Streptococcus gordonii* Attenuate Inflammation

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Objective: Background: The commensal species *Streptococcus gordonii* (*Sg*) serves as a primary colonizer in the subgingival biofilm and has been studied for its role in regulating the pathogenesis of periodontal pathogens such as *Porphyromonas gingivalis* (Pg)and *Aggregatibacter actinomycetemconitans* (*Ag*). Recently, it was verified that *Sg* can reduce the invasion of *Pg* into oral epithelial cells. But its potential anti-inflammatory role on host cells has not been explored.

Objective: The objectives of the study are to explore the anti-inflammation potential of *Sg* metabolites on host cells.

Methods: *Steptococcus gordonii* ATCC 33399 was cultured in DMEM to obtain a *Sg* spent culture supernatant. The *Sg* supernatant was tested on the growth of *Porphyromonas gingivalis* ATCC 33288 and on the viability of human cells. Further, different concentrations of *Sg* supernatant were tested on the proinflammatory cytokines secreted by human macrophages, GMSMKs and HGFs with or without LPS challenge *in vitro*. ELISA and Human Inflammation Array tests were conducted to quantify the anti-inflammatory role of *Sg* supernatant.

Results: 5% *Sg* supernatant can significantly reduce *Pg* growth at both 12hr and 24hr and 10% *Sg* supernatant can inhibit *Pg* growth at 24hr. 5% *Sg* supernatant did not influence the viability of cells or induce inflammation, but rather significantly reduced expression of proinflammatory cytokines *IL-6*, *IL-8* following LPS challenge. ELISA and Inflammation Arrays confirmed the anti-inflammatory effect of 5% *Sg* supernatant.

Conclusion: Sg metabolites may serve to suppress inflammation in subgingival plaque thereby helping maintain periodontal health.

Supported by: High Quality Talent Training Program of School of Stomatology, CQMU.

41. Decellularized Plant Tissues Modified by Phase-Transitioned Lysozyme for Bone Regeneration

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Objective: Decellularized plant tissues have the needed structure and ease of production to serve as the scaffolds for bone tissue regeneration, while are limited by bio-inert property of cellulose. We modified decellularized plant tissues with phase-transitioned lysozyme to improve cell adhesion, proliferation and osteogenesis differentiation.

Methods: To synthesize the materials named as mPCS, decellularized plant tissues (NCS) were modified by nanoscale phase-transitioned lysozyme (PTL), then were mineralized using simulated body fluid (SBF) for surface coating. The physical and chemical properties of the materials were measured by scanning electron microscope (SEM), hydrophilicity test, degradation test, compressive strength test and porosity test. Cell viability, proliferation and spreading were measured. The osteoconductive effect on the BMSCs was evaluated by quantitative real-time polymerase chain reaction (RT-PCR), alkaline phosphatase (ALP) staining and alizarin red staining *in vitro* while the rats' femur bone defect model was used as an *in vivo* study with micro CT and histology. Statistical analysis (SPSS software 25.0) was evaluated using one-way analysis of variance (ANOVA) followed with Student-Newman-Keuls post-hoc test to evaluate the differences among all the groups.

Results: The characterization results showed that there was a significant increase in compressive strength and hydrophilicity of mPCS while maintaining high porosity. PTL coating enhanced cell attachment to the scaffolds mainly due to charge-based interactions and amyloid nano-topography. mPCS had a capacity to promote osteogenic differentiation of BMSCs *in vitro* and bone regeneration *in vivo*.

Conclusion: This study indicated that decellularized plant tissues modified by nanoscale phase-transitioned lysozyme was promising in bone repair application.

42. EVs From Periodontal Stem Cells: Proteomics Analysis and Biomanufacturing Optimization

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Objective: Extracellular vesicles (EVs) from mesenchymal stem cells have emerged as promising therapeutic applications. The goal of this work specifically compares the proteomics and biological activity of EVs from different periodontal stem cells (DFSCs, PDLSCs, GMSCs and SCAPs). We also determine how low-intensity pulsed ultrasound (LIPUS) specifically impacts EV production and potency as a biomanufacturing optimization, which influences periodontal stem cell culture microenvironment.

Methods: Quantitative proteomics by data-independent acquisition mass spectrometry were used to investigate EV protein profile. NTA and BCA analysis were used to measure EV concentration. Migration assay, tube formation assay, western blot, real-time PCR, alkaline phosphatase (ALP) staining and experimental periodontitis mice model were used to evaluate EV biological activity.

Results: A total of 4296 proteins were identified and quantified in all EV samples. Further functional analysis of differentially abundant proteins revealed that SCAPs contains more effector proteins involved in differentiation and anti-inflammation. In addition, SCAP-EVs exhibits superior biological activity, which is enhanced after LIPUS induction.

Conclusion: Among periodontal stem cell derived EVs, SCAP-EVs showed better biological activity. In addition, LIPUS could be a biomanufacturing optimization application for SCAP-EV production and potency.

43. A Novel Machine-Learning Framework Identifies Dental Caries and Periodontitis Biomarkers

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Objective: Oral microbiomes are frequently investigated for biomarkers associated with various health conditions. Exiting methods largely depend on statistical techniques. There is a shortage of using machine learning (ML) techniques for the purpose. Our objective is to design and implement a novel machine learning based framework for biomarker identification. The disease associated biomarkers discovered by our framework has potential for diagnosis, personalized treatment, and prognosis prediction.

Methods: For this study, we used a publicly available metagenomics dataset (BioProject Accession PRJNA396840) to identify bacteria that are associated with periodontal disease, dental caries or healthy controls, each of which consists of 10 samples. We processed the dataset using QIIME1 to obtain an Operational Taxonomic Unit (OTU) table. We then used feature selected methods to identify bacteria that can serve as biomarkers to differentiate periodontal disease, dental caries or healthy controls. The feature selection methods include Correlation, Information Gain, Information Gain Ratio, Relief and Symmetrical Uncertainty. The selected biomarkers were evaluated using 8 classifiers (NaÔve Bayes, Support Vector Machine, Nearest Neighbor, Gaussian Process, Random Forest, AdaBoost, and Logistic Regression) and leave-one-out cross-validation. Specifically, the ROC curve and AUC (Area under the ROC Curve) were used as metric to evaluate how good the selected biomarkers are on classifying different health conditions. Larger AUC value indicates better classification performance.

Results: The results showed that Oribacterium, Fusobacterium, Haemophilus, Porphyromonas, Veillonella, Mogibacterium and an unknown genus in phylum TM7 can act as biomarkers for dental caries (AUC = 1). For periodontal disease, we identified biomarkers including Veillonella, Prevotella (Prevotella nanceiensis and Prevotella intermedia), Aggregatibacter, Fusobacterium, Streptococcus, and Rothia (Rothia mucilaginosa) that performed well for disease classification (AUC=0.99).

Conclusion: Using microbiome data, our computational framework can identify a group of bacteria that can be used as biomarkers to classify dental caries and periodontal disease.

44. Effectiveness of Local Ventilation Controls at Reducing Respirable Aerosol Concentrations

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Objective: Exposure to respirable bioaerosols generated during dental procedures presents a potential risk for the transmission of SARS-CoV-2 in open-operatory settings.

Methods: Ventilation controls (extra-oral suction, intraoral high volume evacuator, Isovac) were evaluated for their ability to reduce respirable aerosols in a multi-chair clinic. Phase one used aerosol photometers to measure aerosol concentrations within an operatory and in adjacent operatories during aerosol procedures. Phase two measured aerosol concentrations throughout a multi-chair clinic at different levels of occupancy while extra-oral suction units were in use.

Results: During phase one, ventilation controls were effective at reducing aerosol concentrations in the procedure operatory and neighboring operatories. There were no significant differences between the ventilation controls used. When no ventilation control was used, high speed handpiece generated the highest level of respirable bioaerosols, followed by air-water syringe, ultra-sonic scaler, and rubber cup prophy. Phase two results indicated that while background adjusted concentrations for each distribution were significantly different, all configurations resulted in aerosol levels very close to, or below baseline.

Conclusion: Results of this study indicate that local ventilation control options were equally effective at controlling respirable aerosols produced during procedures. Use of extraoral suction units across a multi-chair clinic can reduce concentrations of respirable aerosols. Greatest reduction was found when procedures were spread out, although all configurations resulted in respirable aerosol levels lower than baseline with ventilation in all operatories. Ventilation controls should be used with aerosol-generating procedures in open-operatory settings. Extra-oral suctions should be considered as an adjunctive measure to reduce respirable aerosols in open-operatory settings.

45. Factors That Affect Dental Student Interest in Prosthodontics

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Objective: The purpose of this study is to discover dental students' understanding of what a prosthodontist does and the factors that encourage or discourage dental students from pursuing the field of prosthodontics.

Methods: A survey was emailed to all current dental students at UICOD using REDCap software. The survey questions included demographics of the students and their knowledge of prosthodontics and interest in a career in prosthodontics, and along with negative or positive factors influencing those interests. Statistical analysis consisted of descriptive and bivariate analysis (alpha=0.05).

Results: A total of 236 students (52.1% males and 69.4% singles) completed the survey, resulting in a 98.3% response rate. The mean age was 25.2±2.8 years (range=21-43 years). The data revealed that males were more likely than females to seriously consider the specialty of prosthodontics (21.1% vs. 10.7%; p=0.03). Moreover, the students who were seriously considering going into the specialty were more likely to rank the following factors as having a positive rather than a negative impact: pre-clinical dental classes, mentorship from prosthodontic faculty, potential amount of lab work during residency, pre-clinical lab exercises, and the junior clerkship ($p<0.05$ in each instance). The lowest ranked factors were "potential amount of lab work during residency", and educational debt already accumulated.

Conclusion: Males at the University of Iowa are more likely to seriously consider entering the field of prosthodontics. For those considering going into the field of prosthodontics, certain classes, mentorship, and lab work have a positive impact for students. For the subjects that weren't interested in specializing in prosthodontics, lab work, educational debt and certain pre-clinical classes are a larger influence on their decision.

46. Oral Self-Care Function in Older Adults With Various Cognitive Abilities

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Objective: Oral hygiene is generally poor in older adults with dementia. However, how oral self-care function declines as cognitive impairment progresses has not been studied. This study aimed to describe the toothbrushing capacity in older adults with different cognitive levels.

Methods: Fifty older adults with documented cognitive impairment and 9 healthy controls were recruited and categorized into normal, mild cognitive impairment (MCI), mild dementia, moderate dementia, and severe dementia groups based on their cognitive function, assessed using the Mini-Cog and Mini-Mental State Exam. Participants were asked to brush their teeth as they normally would. Cues were given if participants were unable to initiate or complete the task. Participants' performances were scored on four domains; including task initiation, thoroughness, task completion and quality. Descriptive and multi-variated analyses were conducted to examine the association between brushing capacity and cognitive function.

Results: MCI participants were able to independently perform a good quality toothbrushing, comparable to those without cognitive impairment. The mild dementia group could do the same, with brushing quality declining in 20% of the participants. Eighty percent of participants with moderate dementia were able to complete the task without needing assistance, yet oral hygiene only remained fair after brushing in 30% of these individuals. The majority of participants with severe cognitive impairment required assistance to brush their teeth. Among them, 70% presented with fair/poor oral hygiene after brushing. Statistical significance was noted for the association of brushing capacity with cognitive levels after adjusting age, gender and other covariates.

Conclusion: Similar to basic activities of daily living, toothbrushing capacity can be relatively well-preserved until late-stage dementia. However, the quality of care can begin to decline in people with mild dementia. These findings suggest that oral hygiene intervention should focus on quality improvement and be tailored based on patient's oral self-care function.

Supported by: NIH.

47. Effects of Pregnancy Hormones on Growth of Select Dental Colonizers

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Objective: The objective of this study was to observe the effects of pregnancy hormones on maximum growth and growth rates of select dental colonizers. It is hypothesized that the pregnancy hormones will affect the growth of species associated with gingivitis and periodontal disease.

Methods: Microbial growth of cultures in 24-well plates was measured as ocular density (O.D.) with a Tecan microplate reader. Growth media were either thioglycolate or thioglycolate enriched with hemin and Vitamin K, each supplemented with dilutions of progesterone (P), estradiol (E), hydrocortisone (H), or a combination of all three (PEH). The O.D. was recorded every thirty minutes until stationary phase was reached. One set of conditions had three data collection periods,

therefore fit for statistical analysis. Growth curves were generated for *Streptococcus sanguinis*, *Porphyromonas gingivalis*, and *Tannerella forsythia*.

Results: The growth rates of *S. sanguinis*, *P. gingivalis* and *T. forsythia* appeared to be negatively impacted by the presence of all three hormones in combination. This effect, however, was statistically significant only for *T. forsythia*. Conversely, there was a trend toward enhanced growth of *T. forsythia* in the presence of progesterone alone. The maximal growth yields for *P. gingivalis* and *T. forsythia* also appeared to be negatively impacted by the presence of the three-hormone combination, but the changes were not statistically significant. There was also a trend towards improved growth yield for *S. sanguinis* in the presence of progesterone alone.

Conclusion: The progesterone effect on the growth rate of *T. forsythia* and the maximal growth yield of *S. sanguinis* showed enhancement trends. The effect of PEH on all three bacteria trended toward negative effects. These results support the hypothesis that pregnancy hormones have an effect on select dental colonizers.

Supported by: University of Iowa College of Dentistry, Dental Student Research Program.

48. Evaluation of U.S. Dentist Response Rates to Web-Based Surveys

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Objective: The purpose of this study was to evaluate trends in response rates for web-based surveys of dentists in the United States. It is unknown what degree of response rate can be expected with a web-based survey of dentists. A higher response rate is suggested to have a lower risk of non-response bias and higher representativeness. The goal of this study was to answer the question: Which survey design and administration factors are associated with higher response rates in web-based surveys of dentists?

Methods: In this study, we employed a systematic literature search to identify relevant surveys published from 1985-2019. Data were extracted from publications and analyzed using descriptive and bivariate statistics. Binomial logistic regression was used to predict survey design features associated with odds of a dentist returning a survey.

Results: We identified 79 dentist surveys that offered web-based options, with the first web-based survey of U.S. dentists described in a 1999 publication. The mean survey response rates in 2000-2004 were 54.1% and demonstrated significant downward trend through 2019 (F=13.62; p<.0001). For 2015-2019, mean response rates were 23.1%. Multivariable analysis showed that the likelihood of survey response decreased significantly over time. Dentists were significantly more likely to respond to surveys that offered a mixed mode design, incentives, and reminders (p<.0001).

Conclusion: Although response rates have decreased over time, several approaches can be used to increase dentist participation in web-based surveys, including incentives and reminders.

Supported by: University of Iowa College of Dentistry, Dental Student Research Program.

49. Factors Associated With Xerostomia Among Older Adults

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Objective: To investigate factors associated with self-reported dry mouth (xerostomia) among older adults seeking dental care at the University of Iowa College of Dentistry and Dental Clinics (UICOD).

Methods: A query was performed in the University of Iowa College of Dentistry AxiUm database and de-identified data were collected from patients aged 65+ recorded on the date that the initial health history was entered. Among these patients, data about patiensts' medications, gender, age, BMI, tobacco use, alcohol addiction, diabetes, heart disease, joint replacement, allergies to medications, hypertension, and mental disorders were obtained. Evaluation of potential risk factors for dry mouth was performed using univariate and multivariable logistic regression analyses (alpha=0.05).

Results: A total of 11,061 subjects were included in the analysis, 51.5% of whom were women. The mean age in years was 74.2±7.0, the median number of medications was 7 (IQR=4-11), and 38.4% of the participants reported dry mouth. The multivariable logistic regression analysis revealed that subjects with higher number of medications (7+ vs. 0-6) and mental disorders (yes vs. no) were significantly associated with greater odds of having dry mouth after adjustment for other potential risk indicators (number of medications, OR=2.09, 95% CI: 1.90-2.30; mental disorders, OR=1.97, 95% CI: 1.77-2.19).

Conclusion: More medications and history of mental health conditions were strongly associated with xerostomia among older adults seeking dental care at the UICOD.

Supported by: University of Iowa College of Dentistry, Dental Student Research Program.

50. Palatal Shelf Elevation Requires *Arhgap29* in Oral Epithelial Cells

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Objective: *Arhgap29* mutations have been linked to an increased risk for orofacial clefting in mice and humans. However, how *Arhgap29* affects palatogenesis is currently unknown. *Arhgap29* is detected in at least two cell types: oral epithelial and cranial neural crest (CNC). When *Arhgap29* is conditionally deleted in the oral epithelium, our previous studies showed an increase in animals with delayed palatogenesis. We hypothesize that in these cells, *Arhgap29* promotes proliferation. The objectives of this study were two-fold: 1) to investigate the proliferation rate of oral epithelial cells in e14.5 embryos in which *Arhgap29* was deleted and 2) to determine the effect of deleting *Arhgap29* in CNC cells on palatogenesis.

Methods: A floxed *Arhgap29* allele (*A29*^{fl}) was crossed with a Keratin 14 Cre (K14Cre) or a Wnt1 Cre (Wnt1Cre) recombinase driver to conditionally delete *Arhgap29* in oral epithelial or CNC cells, respectively. Prior to sacrifice at embryonic day 14.5, the pregnant mother was injected with BrdU to assess cell proliferation. Coronal sections of embryonic heads were immunostained with an anti-BrdU antibody. Proliferation rate was calculated as the number of BrdU positive cells in the oral epithelium divided by the total number of oral epithelial cells.

Results: Initial data analysis of 3 embryos per group show decreased proliferation in the oral epithelium of *A29*^{fl};*K14Cre* embryos compared to wild types, although not significant. Further, *Arhgap29* in CNC cells is not required for life as *A29*^{fl};*Wnt1Cre* animals exhibit normal Mendelian ratios and survive into adulthood.

Conclusion: Decreased proliferation in *Arhgap29*-deficient oral epithelial cells may explain the delay of palatal shelf elevation in these animals. Loss of *Arhgap29* in CNC cells did not prevent survival, suggesting palatogenesis was complete at birth, yet a thorough evaluation of this process during development is warranted to fully understand the role *Arhgap29* in craniofacial morphogenesis.

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51. IRF6 Variants are Associated with South African Orofacial Clefts

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Objective: The goal of this research was to identify functional genetic variants that may contribute to the risk of developing orofacial clefts in affected South African probands. For years, scientists studied the etiology of cleft lip and palate (CLP) and candidate genes including Grainyhead like transcription factor 3 (GRHL3), Interferon regulatory factor 6 (IRF6), Zinc finger protein 750 (ZNF750), and Sonic hedgehog (SHH) have been found to be associated with the risk of developing CLP in various populations such as European populations and African populations including Nigeria, Ghana, and Ethiopia.

Methods: To identify functional genetic variants that further explain the etiology of orofacial clefts, we sequenced GRHL3, IRF6, ZNF750, SHH in a South African population to determine if rare variants in those gene were associated with the presence of syndromic or non-syndromic CLP. We sequenced the exons of these genes in 48 CLP cases. When necessary, we sequenced the individual's parents to determine the segregation pattern and presence of *de novo* variants.

Results: One novel missense variant (p.Cys114Tyr) was identified in exon 4 of IRF6. This variant was found in a highly conserved position in an individual with cleft lip and alveolus. The variant was absent from all public exome and genome databases including 5,200 individuals from Africa and absent in the individual's mother. Polyphen predicted the variant to be probably damaging, while Provean's prediction indicated the variant may be deleterious and SIFT predicted it would be tolerated. HOPE analyses suggested the variant may disturb the protein's interactions and/or correct folding due to differences in size and hydrophobicity between Cysteine and Tyrosine.

Conclusion: This study provides evidence that variants in IRF6 contribute to the risk of CLP in the South African population. It also provides a molecular diagnosis of Van der Woude syndrome in the affected family. This information will be important for genetic counseling.

Supported by: Iowa Dental Research Grant.

52. COVID-19 and its Effect on Iowa Dental Practices: A Survey

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Objective: To assess the impact of the COVID-19 pandemic on dentists in the state of Iowa as they re-open practices following temporary closures.

Methods: An exploratory cross-sectional survey was designed to assess the perceived impact of the COVID-19 pandemic on Iowa dentists and their practices. The 44-item survey was distributed in June 2020 through the Iowa Dental Board COVID-19 Newsletter to all current licensed dentists in the state of Iowa (n=2,300). Descriptive, bivariate, and multivariable logistic regression analyses were conducted (alpha=0.05).

Results: Ninety-six participants (56.8% males and 52.6% age of 50+ years old) completed the survey; 52.1% were solo private practice owners and 77.1% were general dentists. A number of respondents (27.1%) considered closing or selling their dental practice. Additionally, 32.6% anticipated seeing fewer Medicaid patients and 51% were very likely or somewhat likely to utilize teledentistry.

Multivariable logistic regression analysis showed those who were in private practice as a solo owner of one office location (OR=11.76, p<0.001) and who had no existing plan for long-term office closure due to emergencies (OR=4.44, p=0.027) were more likely to consider closing or selling their dental practice due to the pandemic.

Conclusion: COVID-19 has caused Iowa dentists to consider and/or deal with difficult changes to their practices, including but not limited to office closure, teledentistry, and changes in payer or payer mix.

53. Factors Associated with ECC in WIC-Enrolled Children Aged 12-36 Months

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Objective: Early childhood caries (ECC) is a chronic disease that remains highly prevalent in low-income children. This study evaluated risk factors associated with non-cavitated and/or cavitated lesions among children aged 12-36 months enrolled in the University of Iowa's Infant Oral Health Program (IOHP) located at a local WIC clinic.

Methods: Data from the first IOHP visit of 1,491 children seen between July 1998 and August 2018 consisted of demographic, oral hygiene practices, feeding/dietary habits, and clinical variables were reviewed for a cross-sectional study. Simple and multivariable logistic regression analyses were conducted (alpha=0.05).

Results: Children (51% female, 72% non-Caucasian) were aged 20.6±6.9 months with 13.5±5 teeth. One-hundred and eighty-seven children had non-cavitated and/or cavitated lesions (ECC-Group), while 1,304 were caries free (Caries-Free Group). Compared to the Caries-Free-Group, multivariable logistic regression analysis showed that the subjects in ECC-Group were more likely to have parents with language barrier (OR=1.73; P=.019), have a crying temperament (OR=2.18; P=.007), co-sleep with the mother (OR=1.08; P=.022), be breastfed when having problems falling asleep (OR=2.97; P=.003), have inadequate fluoride exposure (OR=1.71; P=.049), and have more teeth (OR=1.17; P<.001).

Conclusion: ECC associated risk factors among young WIC-enrolled children included factors from multiple domains related to the child and caregiver.

Supported by: University of Iowa College of Dentistry, Department of Pediatric Dentistry.

54. Fluoride Refusal by Parents of Pediatric Dental Patients

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Objective: The objective of this study was to determine the prevalence and characteristics of families who refused topical fluoride for their children.

Methods: Data were abstracted through an EHR (Axium) manual chart review of all University of Iowa Department of Pediatric Dentistry patients who did not receive a fluoride code during at least one exam visit from 6/30/18 to 1/1/2020. Statistical analyses consisted of descriptive and bivariate analyses (alpha=0.05).

Results: Over the study period, 5,833 patients always had a fluoride code associated with their exam appointment, while 1,534 patients did not. Of those patients without a fluoride code, 990 (64.5%) were confirmed to not have had topical fluoride applied during a dental exam. The most common reasons for the lack of fluoride application were as follows: procedure not covered by insurance/cost (8.1%), patients' behavior (9.8%), parental refusal (16.4%), and "other" reasons (70.6%) such as patient had a low caries risk, chlorhexidine was used, or the reason was not listed. Bivariate analysis revealed that subjects who were from states other than Iowa (23.3% vs. 10.2%; p=0.006), had no caries experience (16.6% vs. 8.5%; p<0.001), and who were treated by students compared to faculty or residents (32.2% vs. 11.6% vs. 6.0%; p<0.001) were more likely to refuse fluoride treatment. On the other hand, subjects who had private insurance (8.2% vs. 12.3%; p=0.009) were less likely to refuse fluoride treatment due to parents' refusal or hesitancy. Additionally, age,

sex, type of clinics, and speaking Spanish were not statistically significant associated with parental refusal of fluoride.

Conclusion: Prominent distinctions were found for the reasoning of fluoride refusal. Additional research is needed to assess whether there are significant relationships between the demographic and clinical characteristics of parents who accept or refuse fluoride.

Supported by: University of Iowa College of Dentistry, Dental Student Research Program.

55. Antagonisms Between *S. mutans* and Streptococci From Children

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Objective: Caries is the costliest disease in dentistry. Caries is best described as a disease caused by an imbalance in the oral microbiome that brings about decay in the dentition. This imbalance may include elevated levels of *Streptococcus mutans* at the expense of more common *Streptococcus* plaque colonizers. We hypothesized that *S. mutans* strains from children with a history of caries will be more likely to exhibit inhibitory activity towards non-mutans commensal streptococci than *S. mutans* strains from caries-free children.

Methods: Using previously collected samples from carious and non-carious children, we investigated growth inhibition between *S. mutans* and commensal strains collected from the children. Each strain was inoculated on a brain heart infusion agar and left to grow for twenty-four hours. The opposing strain was then inoculated next to the initial inoculation and after twenty-four hours, inhibition was measured. This was done by plating *S. mutans* first and then also by plating the commensal strains first.

Results: We discovered that while our data trended in the direction of supporting our hypothesis, it was not statistically significant. The *S. mutans* from children with caries were slightly more inhibitory towards commensal strains than those without. Conversely, commensal strains from carious children tended to show greater inhibition toward *S. mutans* when compared to the inhibitory effect of commensal strains from children without caries but these differences were also not statistically significant.

Conclusion: In conclusion, antagonisms between *S. mutans* and other streptococcal plaque species did not correlate with caries history.

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56. Probiotic Candidates Show Variable Antagonisms Against *Streptococcus mutans* Clinical Isolates

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Objective: To examine potential probiotic strains for *in vitro* inhibitory activity against clinical isolates of the highly acidogenic and cariogenic species, *S. mutans*. The potential probiotic strains, previously isolated as mildly acidogenic streptococci from caries-free subjects, showed good inhibitory activity against a laboratory strain of *S. mutans*, but determining the breadth of that activity against clinical strains is essential for assessing probiotic potential for reducing caries risk.

Methods: Prospective probiotic strains (n=4) and clinical isolates of *S. mutans* (n=8) were inoculated next to one another on agar plates. Multiple trials were conducted in which either the probiotic test strains or the *S. mutans* clinical isolates were inoculated first and incubated for 24 hours prior to the inoculation of the other. Growth inhibition was measured in millimeters as a percentage of the total diameter of the inoculation. Additionally, the prospective probiotic strains were identified using Multi-Locus Sequence Analysis (MLSA).

Results: The prospective probiotic strains showed significant variation in their abilities to inhibit clinical isolates of *S. mutans*. One clinical strain of *S. mutans*, 9.1.24, showed over 90% inhibition of all the potential probiotic strains. MLSA sequencing did not yield definitive species classifications, but revealed that each of the probiotic candidates are most closely related to the common oral streptococcal species *S. oralis*, *S. mitis*, and *S. australis*.

Conclusion: The research shows inhibitory activity against *S. mutans* is highly variable and identifying a probiotic that can inhibit all strains of *S. mutans* could be challenging. Future research should employ clinical *S. mutans* isolate 9.1.24. Identifying a clinical strain that inhibits 9.1.24, while resisting being inhibited, may be necessary to maximize the effectiveness of a probiotic against *S. mutans*-based caries.

Supported by: Iowa Dental Research Grant.

57. Anti-Bacterial and Cytotoxicity Comparisons Across Toothpaste Formula Suspensions

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Objective: Anti-bacterial and cytotoxic effects of various dentifrice formulas are important to establish in order to maximize benefits and reduce potential risks of oral irritation when appropriately selecting a commercial toothpaste and creating a new formulation. This is particularly important in individuals with existing chronic oral inflammation.

Methods: A workable toothpaste suspension method was established and followed to prepare standardized supernatants for comparative further testing. The suspensions were then serial diluted in wells of 96 well microtiter plates. An equal volume of broth containing 105 CFU/ml of test bacteria were added and the plates incubated at 37oC. At 24 hours, the optical density (OD) of the well turbidity was determined at 600 nm. The minimal inhibitory concentrations (MIC) were determined as the lowest concentration of suspension treatment found to reduce the OD of microbial growth by more than 50% of the OD of microbial growth in the positive growth control wells without suspension. Well contents with no OD was then spotted onto appropriate agar and the minimal bactericidal concentrations (MBC) were determined as the lowest concentration of suspension treatment that produced viable growth from the wells.

Results: Differences were seen in the susceptibility across bacterial species, and *E. coli* and *F. nucleatum* were the most susceptible across all samples. Looking across suspension ingredients in treatments, formulas containing sodium lauryl sulfate, pyrophosphates, and peroxides were most active with the lowest MIC and MBC values. Formulas containing potassium nitrate, methocel, sodium hydroxide, xylitol, and sorbitol were the least active with higher MIC and MBC values.

Conclusion: Differences in toothpaste formula suspensions and bacteria showed varying degrees of susceptibility. Future work will assess the effects of these formulation on oral keratinocyte cytotoxicity.

Supported by: University of Iowa College of Dentistry, Department of Oral Pathology, Radiology and Medicine.

58. Objective and Subjective Noise Exposure Assessment with Dental Extraoral Suction

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Objective: While extraoral suctions are introduced to dentistry to reduce COVID-19 infections, can these machines increase the risk of noise-induced hearing loss? This study measures the noise levels using the extraoral suction with common dental instruments at patient and doctor's ear positions and compares these measurements with the subjective perceptions of noise.

Methods: Three measurements were conducted on different days in the Bigelow orthodontics clinic. A sound level meter using the A-weighted scale (dBA) was used to measure noise levels at the dentist's and patient's ear positions with following instruments: the extraoral suction at three settings (low, medium, maximum), slow-speed handpiece, high-speed handpiece, saliva ejector, high-volume evacuator, and a combination of the high-speed handpiece, high-volume evacuator, and the extraoral suction at maximum setting. A survey about noise perception will also be created for both clinicians and patients.

Results: Noise levels were significantly louder at the patient's ear than at the doctor's ear by 4 dB (SD = 2.39) for all instruments used ($t = 4.17$, $p = 0.004$). The highest noise levels were measured using the combination of three instruments at the patient's ear, reaching 93 dBA for the peak response and 83 dBA for the slow response. The three settings of the extraoral suction resulted in significantly different sound levels ($F = 5.41$, $p = 0.029$): using either the medium or maximum setting elicited higher noise levels than using the low setting. Also, the measured noise levels of the extraoral suction at medium setting alone were significantly higher than any other instruments ($t = 18.76$, $p < 0.0001$) by 17 dB (SD = 3.68).

Conclusion: Results indicate more noise exposure using the extraoral suction in dental clinic for both patients and clinicians. Subjective noise perception as well as active noise hearing protection devices will be discussed at the presentation.

Supported by: University of Iowa College of Dentistry, Dental Student Research Program.

59. COVID-19 Pandemic and Its Impact on Dental Students: A Multination Survey

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Objective: To investigate dental students' perceptions and concerns regarding the COVID-19 pandemics, their coping strategies and support resources, and their perceived stress levels.

Methods: A sample of undergraduate dental students from the US, Spain, Ireland, Chile, India, and Brazil answered a customized 19-item survey and the Perceived Stress Scale (PSS). Linear modeling and mediation analysis were used to explore the relationships among demographics, stressors, coping mechanisms, social support, and stress.

Results: A total of 4,475 students responded to the survey. The majority (72.4%) were women, and 52.3% had no COVID-19 training at the time of the survey. The students reported that they had to accommodate to changes in patient care (96.6%) and didactic (95.2%) activities, while 88.4% of the courses moved online. Transition to online courses went "smoothly with some troubles" for 51.8% of the respondents, and 48.3% perceived the faculty was prepared for the online transition, however, 45.9% reported feeling extremely concerned about the impact of COVID-19 on their education. The average PSS score was 21.9 (moderate stress). Multivariate models were built for participants with full data (n = 3899). Being male, having completed more dental coursework, and perceiving a smoother transition were associated with lower PSS scores; and more concern about academic progress was associated with higher PSS. Faculty support mediated the relationship between a smoothness of transition and concern about academic progress and PSS scores.

Conclusion: Stress caused by the pandemic may be alleviated by smoother transition and good faculty support.

Supported by: University of Iowa College of Dentistry, Dental Student Research Program.

60. Infection Control Changes for Covid-19 in Iowa Dental Practices

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Objective: With the advent of the novel coronavirus (i.e., Covid-19), dentistry has had to re-evaluate its operating procedures, from personal protective equipment and disinfection procedures, to patient scheduling and office protocols. This survey was designed to look at these areas to see what dental practices are doing now, and hope that the information gained will help us determine what the "best practices" are, and what changes dental professionals have had to make for the sake of patient and provider safety.

Methods: A 66-item survey was developed and its content validity was analyzed using the content validity index. The final survey was sent electronically to the University of Iowa College of Dentistry graduates, asking for reponses only from those practicing in Iowa (n= 886), from July 29 to September 1, 2020. From this initial group, 246 responses were retrieved on September 14, 2020.

Results: The majority of the respondents (54.7%) graduated in or after the year 2000, work in a group (44.6%) or solo practice (41.4%), and are general practitioners (75.5%). Practices are located mainly in SE Iowa (25.5%), NE Iowa (24.8%) and South Central Iowa (22.1%), with a higher prevalence of urban practices (69.9%). Many changes happened with regards to office routines (no longer shaking hands-100%, limiting number of patients-99.1% and escorts-98.6% allowed, temperature checks-98.2%), and common PPE additions were face shields (91.2%), N95 or PAP respirators (87.4%) and full length coat with long sleeves (74.8%). The most common change in dental procedures was the incorporation of preprocedural mouth rinses (67.6%), but only 24.3% added extraoral dental suction units and

just 23.5% increased the use of rubber dams. Scheduling routines also changed, with the addition of pre-screening by phone (92.3%), longer appointment times (73.2%), and use of teledentistry (26.1%).

Conclusion: Iowa dentists responded to the COVID-19 pandemic by adding new office practices and PPE, incorporating preprocedural mouth rinses and modifying scheduling routines.

61. Formation of a Dental Biofilm by Non-Mutans Low pH Streptococci

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Objective: Previous research identified seven strains of low pH non-mutans streptococci from three child donors with varying caries histories. These low-pH streptococci may play a role in the initiation of a dysbiosis in the oral microflora that leads to caries initiation. The purpose of this study was to: compare the abilities of these low pH strains, to each other and to *S. mutans* (positive) and *S. sanguinis* (negative) controls, to produce an adherent sucrose-based biofilm by measuring both total biofilm biomass and extracellular polysaccharide.

Methods: Banked stocks of low-pH streptococci and controls were revived and grown on Brain Heart Infusion (BHI) agar plates. Suspensions of each strain were standardized to an optical density of 0.10±0.005 at wavelength 540nm. Bacterial suspensions were added to wells of a 24-well plate containing BHI, 3% artificial saliva and 1% sucrose in triplicate. To a separate, duplicate plate, 1.5 uL of Alexa Fluor 647 was added to each well. Plates were incubated for 24 hours, washed twice, and absorbance measured at 540 nm (plate without Alexa Fluor) or 668 nm (plate with Alexa Fluor). 1 mL of PBS was then added to each well, the biofilm dislodged by sonication, and absorbance again measured. Two independent trials were conducted.

Results: Two low pH strains, one from a donor with a history of caries and one from a caries-free donor, produced biofilms of greater biomass than that of the negative control, *S. sanguinis*. The strain from the caries-free donor produced biofilm at a level equal to or exceeding that of the *S. mutans* positive control. The remaining 5 strains, all from the same donor, did not produce a measurable biofilm.

Conclusion: A subset of low pH streptococci are capable of producing robust sucrose-based biofilms, but this property did not correlate with caries history.

Supported by: University of Iowa College of Dentistry, Dental Student Research Program.

62. A Tool for Incorporating Interprofessional Perspectives into Dental Students Decision-making

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Objective: To analyze student performance when using a teaching tool developed to guide learning about interprofessional perspectives.

Methods: This study compiled data about D4 students' performance when using an interprofessional education (IPE) teaching tool, during their five-week Geriatric and Special Needs Program rotation in the academic years 2018-2019 and 2019-2020. Students were introduced to IPE concepts and teaching tools during their orientation. Students were then asked a question regarding the perspective of each health care team member and whether they would contact these healthcare team members for collaboration during the provision of oral care with regard to various patient cases. Students were scored on whether they answered the question about the perspective of each healthcare team member as either applied the step (A), missed the step (M), or not applicable (N/A) to their case. The same two independent evaluators also noted whether the student thought each member of the healthcare team should be contacted.

Results: A majority (85.2-95.1%) of dental students applied their knowledge to questions regarding each healthcare team member's perspectives. The profession that dental students most often indicated they wished to contact for collaboration was primary care providers (73.5%), followed by family caregivers (56.8%), and pharmacists (46.2%). Less commonly indicated to be contacted were nurses (35.0%), nutritionists (32.5%), and physical therapists/occupational therapists (23.9%). The results of the interrater agreement between the two-faculty scoring the students were between 86.7% and 100%.

Conclusion: In this two-year observation period, students considered the perspectives of each healthcare team member at a rate above 85%, and the interrater agreement was high among the faculty evaluators. For student cases in the Geriatrics and Special Needs Clinic, students considered contacting primary care providers, family caregivers and pharmacists more often than the other healthcare team members.

Supported by: University of Iowa College of Dentistry, Dental Student Research Program.

63. Assessing Access to Dental Care for Seniors in Rural Iowa

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Objective: Rural communities face unique challenges for accessing and utilizing dental services, such as provider shortages and insurance coverage. Seniors face significant challenges accessing dental care as well as comprising a large proportion of the rural population. Some of these challenges include lack of insurance coverage, limited income, and transportation. The purpose of this research study is to investigate the following research questions: What barriers to dental care are persisting in rural Iowa communities for seniors? What roles do existing programs and resources play in alleviating the barriers that seniors in rural Iowa communities face with accessing dental care?

Methods: Researchers conducted structured interviews with members from Iowa Department of Public Health, Area Agency on Aging, I-Smile™ Silver Coordinators, Iowa Department on Aging, and Iowa Dental Association. Of the recruited interviewees, nine interviews were completed with fourteen people in either group or individual discussions. Audio data collected from the interviews were verbatim transcribed using Rev transcription service and analyzed in Nvivo.

Results: Among prevailing barriers discussed, provider issues, transportation, and lack of insurance coverage were the most cited obstacles. Furthermore, I-Smile™ Silver, Area Agency on Aging and Donated Dental Services were the most identified existing programs to help seniors overcome the persisting barriers. Expanding I-Smile™ Silver to be a statewide program and increasing oral health education of seniors were the most identified ways to improve access to dental care.

Conclusion: Our interviews have shown that many issues identified in literature as difficulties for seniors in accessing dental care continue to persist in Iowa communities. While there are many existing programs and resources in place to address some of these issues, our interviews demonstrate that the barriers remain, despite existing resources.

Supported by: Iowa Dental Research Grant.

64. Preliminary Validation of Ageism Scale for Dental Students in India

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Objective: To perform a preliminary validation of the Indian version of an ageism scale for dental students (ASDS).

Methods: 27-question ASDS was administered to 3rd and 4th year undergraduate dental students at DY Patil Dental School. The data was analyzed using Principal Component Analysis (PCA) with an orthogonal, Varimax rotation. The Kaiser-Meyer-Olkin (KMO) and Bartlett's Test of Sphericity statistics were used to check for the adequate factorability of the sample.

Results: ASDS was administered to 11 third year and 169 fourth year dental students. The factorability was confirmed by Bartlett's Test of Sphericity yielding $p < 0.001$ but failed with a Kaiser-Meyer-Olkin (KMO) value of 0.56. PCA was unable to configure a reliable scale with the preliminary data obtained from this sample.

Conclusion: This preliminary attempt to validate the Indian ageism scale failed. It is plausible that there was an issue with comprehension of the minor differences between the items, maybe due to cultural factors. To better understand why this happened the ASDS content validity is being re-assessed for the Indian context. The problem reported here should highlight the importance of performing a careful content validity analysis when applying the ASDS to a specific country, even if the language is the same, as ASDS seems to be heavily influenced by cultural factors.

Supported by: University of Iowa College of Dentistry, Dental Student Research Program.

65. Adults With Autism Seeking Dental Care: A Descriptive Analysis

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Objective: To investigate the demographic, systemic health characteristics, and type of dental procedures of adults with autism seeking care at The University of Iowa College of Dentistry (UICoD).

Methods: The UICoD AxiUm database was searched and de-identified data were collected from patients aged 18+ that have self-reported autism in their health history. Data for the following variables were retrieved: age, gender, BMI, mental health, heart disease, xerostomia, tobacco use, alcohol use, diabetes, use of drugs, seizures, total number of medications, and the type and number of dental codes within each code category provided to these patients. Univariate and bivariate analysis were performed for this initial, descriptive analysis.

Results: Data from 244 patients were retrieved, showing that mean age was 29.8 years (±12.3), 64.8% were males, and mean BMI was 29.9 (±8.1). Mental health condition was reported by 79.9%, heart disease by 25.4%, xerostomia by 21.7%, 20.9% reported the use of tobacco, 18.9% reported the use of alcohol, 14.8% reported having diabetes, 10.2% reported the use of drugs, and 3.7% reported having seizures. The median number of procedures per patient was 9, and the median timespan of their treatments was 0.4 years. Most common procedures were exams (mean of 7.6), followed by preventive (5.7), operative (2.9) and surgical (2.3) procedures. Older individuals tended to have a higher proportion of their procedures from diagnostic (exam) codes and a lower proportion of their procedures from surgery or anesthesia codes.

Conclusion: Adult patients with autism seeking care at the UICoD tended to be overweight/obese young males, and the majority did not report having seizures. Most common dental procedures were exams, followed by preventive, operative, and surgical procedures.

Supported by: University of Iowa College of Dentistry, Dental Student Research Program.

66. Inter-Rater Reliability of a Study in Patients Receiving Palliative Care

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Objective: Inter-rater reliability is an essential tool in ensuring data quality in clinical studies that involve multiple data collectors. Analyzing inter-rater reliability provides researchers confidence in using subjective data to draw conclusions from. The present study aimed in assessing inter-rater reliability between interviewers, as a part of a study to understand the oral health concerns and perceived oral health care needs in persons receiving palliative care (PRPC).

Methods: Among the 49 participants of the parent study, 11 agreed to participate in the second round of the interview. Six of the eleven participants were PRPC and five were caregivers of the PRPC. They were recruited from the University of Iowa Hospitals and Clinics Palliative Care Clinic and the University of Iowa College of Dentistry Geriatric and Special Needs Clinic. Participants were interviewed with the same structured questionnaire used in the parent study a second time, but with a different interviewer to measure inter-rater reliability. Descriptive and agreement analysis was used to calculate agreement between two interviewers in the quantitative portion of the questionnaire.

Results: We included 22 total records (11 for rater 1 and 11 for rater 2). The median age of participants was 63 years old, 36% percent of participants were male and 64% were female. The majority of participants had an education level beyond high school. We found that participants provided a matched answer in 84% of the questions when interviewed with different raters.

Conclusion: The results demonstrated that interview data collected by two interviewers showed a high percentage of an answer agreement in the PRPC and caregiver participants, suggesting high data quality in the structured interview of the parent study.

67. Activities of Daily Living and Difficulty Eating Among Older Iowans

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Objective: This cross-sectional study aimed to evaluate the relationship between older adults' degree of dependency on others and difficulty eating.

Methods: The Iowa Department on Aging (IDA) periodically surveys community-dwelling older Iowans to determine their eligibility for IDA-sponsored social programs. This study evaluated data from

all participants age 65+ surveyed between March-December 2017 regarding variables related to dental utilization; demographics; activities of daily living (ADLs); and instrumental activities of daily living (IADLs). After univariate and bivariate frequencies were generated and evaluated, multivariable logistic regression models were generated in which -- depending on the modeling strategy — the number of ADLs (out of six); the number of IADLs (out of eight); and/or individual ADLs/IADLs served as exposure variables, while the subjects' response to the question "I have tooth or mouth problems that make it hard for me to eat" was the outcome variable. Variables were required to have $p<0.05$ to be retained in the models.

Results: From the total of 2692 subjects surveyed, 2160-2516 (80%-93%) responded to ADL and IADL questions, while 2072 (77%) responded to the outcome question. In general, the greater number of ADLs/IADLs corresponded with a higher percentage reporting difficulty eating due to mouth problems. Also, depending on what modeling strategy was employed, the ADLs/IADLs most commonly associated with the outcome were the ADLs "eating" and "bathing"; and the IADL "phone use". Depending on the variables included in the models, the c-values for the models ranged from 0.519-0.561.

Conclusion: In this sample of community-dwelling older Iowans, dependency on others with regard to eating, bathing, and phone use were most closely associated with difficulty eating due to tooth or mouth problems. These ADLs/IADLs might serve as meaningful indicators in targeting this population for subsequent dental evaluation.

Supported by: University of Iowa College of Dentistry, Dental Student Research Program.

68. Iowa Medicaid Member Preferences for Maintaining Full Dental Benefits

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Objective: Within Iowa's Dental Wellness Plan (DWP) for Medicaid-enrolled adults, members must complete two healthy behavior requirements (HBRs) annually to keep full dental benefits: a preventive dental visit and oral health self-assessment. If HBRs are not completed, they must pay a $3 monthly premium or risk a reduction in coverage to basic benefits. The aim of this study was to examine member preferences about whether, and how, members want to maintain full benefits.

Methods: The data source was a 2019 survey of DWP members. The dependent variable was member preference for maintaining full benefits, with response options: (1) Complete the healthy behaviors, (2) Pay $3 per month, or (3) Neither; I don't need/want full benefits. Independent variables included measures of plan awareness, access, and individual characteristics. Univariate and Chi-square analyses were completed.

Results: The survey response rate was 15.2% (n=2727). Among respondents, 82% preferred to complete the healthy behaviors, 12.8% preferred to pay premiums, and 5.2% preferred neither. Member preference to keep full benefits was significantly associated with measures of awareness, access, and individual characteristics. Those most likely to prefer completing HBRs were aware of the oral health self-assessment requirement (89.1%). Those most likely to prefer paying premiums were definitely able to pay $3 per month (22.8%). Those most likely to prefer neither were edentulous (19.0%).

Conclusion: Most members prefer to keep full benefits, and the majority would prefer to complete the HBRs. Member preference was strongly associated with numerous indicators of plan awareness and access.

Supported by: University of Iowa College of Dentistry, Dental Student Research Program. Iowa Department of Human Services.

69. Dentist Attitudes Toward an Annual Benefit Maximum in Iowa Medicaid

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Objective: The Dental Wellness Plan (DWP) provides dental coverage for adult Medicaid enrollees in Iowa. In September 2018, a $1,000 annual benefit maximum (ABM) was implemented. The aim of this study was to explore private dentists' attitudes toward the ABM.

Methods: The data source was a mailed survey administered in spring 2019 to all private practice dentists in Iowa. Two dependent variables were attitude toward the $1000 ABM and attitude toward *any* ABM. A 5-point Likert scale was used in the survey to record the dentists' attitudes and was collapsed to two categories for analysis: positive and negative attitudes. Independent variables were demographic and practice-related factors, and attitudes toward other aspects of the DWP. Quantitative analyses (descriptive and bivariate) and qualitative analyses (coding open-ended comments) were conducted.

Results: Approximately 37% of dentists had a positive attitude toward the $1000 ABM, 54% had a negative attitude. Over half (52%) of providers reported a positive attitude toward any ABM, 36% were negative, and 13% had no opinion. Among providers with an opinion, the independent variables with the strongest association with both dependent variables were attitudes toward the DWP overall ($p<.001$), and attitude toward healthy behavior requirements ($p<.001$). Providers with a negative attitude toward the ABM were more likely to have negative attitudes toward other aspects of the DWP. The most common qualitative theme among provider comments was that the maximum is too low.

Conclusion: While a majority of providers had a negative attitude toward $1000 ABM, a majority also had a positive attitude toward *any* ABM. There were strong associations between attitudes toward ABM and attitudes toward other aspects of the DWP.

Supported by: University of Iowa College of Dentistry, Dental Student Research Program.

70. Variables Associated with Changes in Students' Attitudes Post Poverty Simulation

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Objective: To assess which demographic characteristics and past experiences of participants are associated with changes in attitudes about poverty after participating in a poverty simulation.

Methods: 172 third year dental students participated in poverty simulations in August 2018 (N=89) and August 2019 (N=82). A 20-item survey assessing students' beliefs about poverty was distributed immediately before and after the simulation (maximum positive belief score=20). Responses from the pre- and post-surveys were matched so that changes in belief scores could be evaluated. The surveys were then linked to questionnaires that participants had completed as first and second-year students assessing their demographic characteristics and their experiences and attitudes about working with underserved populations. Descriptive and bivariate analyses were conducted to identify which variables were significantly associated ($p<0.05$) or trending towards association ($p<0.2$) with a positive change in belief scores.

Results: n=119 (response rate = 70%). Pre-simulation scores ranged from 0-20, while post-simulation responses ranged from 3-20. Eleven (9%) respondents did not undergo a change in beliefs. Fifteen (13%) respondents exhibited a negative change, while 93 (78%) respondents exhibited positive changes. Positive changes were more often associated with individuals who reported weekly or monthly past volunteer experiences compared to irregular volunteerism. Respondents who believe it is their responsibility to treat underserved populations or reported positive professional experiences with individuals receiving Medicaid were often associated with positive changes compared to respondents who did not feel it is their responsibility to treat underserved populations or reported negative experiences with individuals receiving Medicaid. Respondents who anticipated larger amounts of debt upon graduation were more often associated with a positive change compared to respondents who anticipated no or minimal debt.

Conclusion: Beliefs and experiences of dental students, rather than demographic characteristics, were more often associated with changes in attitudes about poverty after participating in a poverty simulation.

Supported by: University of Iowa College of Dentistry, Dental Student Research Project.

71. Patient Perspective on Return of Incidental Findings in Africa

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Objective: Orofacial clefts (OFCs) are the most common birth defects of the head and neck region, affecting 1 out of 700 live births worldwide. OFCs lead to significant financial, educational, medical, psychological, and cultural problems and may require treatment throughout adulthood. Whole genome sequencing (WGS) is a cost-effective way to identify causal variants in OFC. Our group has generated data from the first WGS effort for OFC in African population. WGS data also provides an opportunity for the identification of secondary findings like sickle cell anemia, G6PD deficiency, and other single gene disorders that may impose medical implications for those in the study or their family members. Secondary findings may impose some burden on families. Therefore, the objective of this study was to determine how to manage incidental findings in a resource-limited setting by determining the interest of OFC families in incidental genetic information and medical risks, including possible identification of infectious disease and the outcomes of those who choose to be informed.

Methods: In November of 2020, a pilot Qualtrics survey was administered to recruited families from cleft-craniofacial clinics in Ethiopia, Ghana, and Nigeria.

Results: In the pilot, nine mothers completed the survey. Seven agreed that they would want to know about secondary findings, one did not agree nor disagree, and one disagreed. When asked if they felt that there were currently available resources that allowed them to access genetic information that they wanted to know, five agreed and four disagreed.

Conclusion: In this pilot, the biggest barrier that we observed was access to genetic information at the OFC clinics in Africa. The validated survey instruments will

be distributed from December 1, 2020 until February 28, 2021. It will assess patient's willingness to receive information regarding secondary findings and available resources in Africa to deal with secondary findings.

72. Current Endodontic Emergency Trends by Board Certified Endodontists

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Objective: The purpose of this study was to investigate the current trends of dental emergency management performed by board certified endodontists.

Methods: A 16 question online survey was conducted regarding different emergency situations arising in an Endodontic clinic. The survey asked Endodontists if pulpotomy, pulpectomy, or complete instrumentation is typically completed in each emergency scenario. Finally, questions regarding incision and drainage as well as different prescription regimes were also recorded. The survey was conducted using Qualtrics survey model and sent out to all board-certified endodontists in the United States. Responses were recorded and a quantitative analysis was performed.

Results: 1292 emails were sent, and 235 surveys were completed. Complete instrumentation was preferred over pulpotomy and pulpectomy in all the scenarios presented. Regarding localized fluctuant swelling, incision and drainage was the preferred treatment of choice regardless of drainage obtained through canals or not, 57% and 95% respectively. Diffuse swelling management differed depending on if drainage was obtained through the canals or not, 32% and 54% respectively. Additionally, when diffuse swelling was present, antibiotics prescription was preferred. For patients in pain, corticosteroid and opioid prescription was not favored.

Conclusion: Within the limitations of this study, we could observe that the current dental emergency management trends by board certified endodontists include: complete instrumentation, incision and drainage as well as antibiotic prescriptions when swelling is present. Lastly, prescription of corticosteroids and opioids for pain relief was not preferred according to this survey.

73. Evaluating the Accuracy of Fiber-Optic Transillumination to Detect Longitudinal Fractures

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Objective: Many clinical and patient factors suggest that a tooth is cracked, but a proper diagnosis of a longitudinal fracture is only possible by direct visualization. Fiber-optic transillumination is an adjunctive clinical tool to detect a crack by passing an intense beam of light through the crown of a tooth to inspect for light transmission. The purpose of this study is to determine the sensitivity of fiber-optic transillumination in detecting a longitudinal fracture.

Methods: A total of nine teeth extracted due to a suspected non-restorable longitudinal fracture between February 2020 and November 2020 were included. Following extraction, each tooth was analyzed for the presence of a longitudinal fracture under a microscope. The patient's medical records were reviewed to determine what factors indicated a non-restorable crack, including: pulpal and periapical diagnosis, presence and type of restoration, transillumination results, and periodontal probings.

Results: Of the nine teeth analyzed, all samples contained a post-extraction longitudinal fracture. Eight of the nine samples were molars. All samples blocked light transmission when fiber-optic transillumination was applied.

Conclusion: Fiber-optic transillumination is a useful adjunctive tool to aid in the detection of a crack. Several clinical findings, including isolated probing depths, cumulatively suggest the presence of a crack when assessing tooth restorability.

Supported by: University of Iowa College of Dentistry, Department of Endodontics. AAE Foundation.

74. Survey of Concentration of Sodium Hypochlorite Used in Endodontic Treatment

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Objective: There has been many studies regarding the efficacy of different concentrations of sodium hypochlorite used as endodontic irrigant. The objectives of this survey were to find out a) What concentrations of sodium hypochlorite irrigation are endodontists and general dentists using?, b) Is there a difference in concentration of sodium hypochlorite irrigation used based on experience of the practitioner?, c) What is the most common consideration for practitioners when deciding which concentration of sodium hypochlorite irrigation to use?

Methods: A total of 5,237 email invites were sent out to endodontists and general dentists. The survey was created on Qualtrics, consisting of 18 questions. The questions included background information of the respondent, selection of irrigation solution and concentrations as well as adjunct procedures and rationale behind their selection. Statistical analysis consists of descriptive and bivariate analyses (alpha=0.05).

Results: Out of 5,327 email invites, 656 subjects (78.5% males, 44.2% age of 50+ years old) completed the survey, with an overall completion rate of 12.3%. The majority of both endodontists and general dentists (66.7%) selected antibacterial property, followed by tissue dissolution (25.1%) as the most important reason for selection of concentration of sodium hypochlorite. No statistically significant associations were found between scope of practice and use of sodium hypochlorite irrigation. However, age, area of practice, years since graduation from endodontic training or dental school, degree or certification from the endodontic program, number of endodontic cases treated each month, time taken to complete anterior/premolar treatment, and the most important reason for selection of concentration of sodium hypochlorite were significantly associated with use of different concentrations of sodium hypochlorite ($p<0.05$ in each instance).

Conclusion: The majority of respondents to this survey favored the 4-6% sodium hypochlorite, however selection differed based on the experience of the provider. Antibacterial property was the main consideration in selecting sodium hypochlorite concentration.

75. Descriptive Study of the Cervical Spine Non-Segmentation Using CBCT

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Objective: Vertebral non-segmentation defines as segmentation failure of the vertebrae. The congenital non-segmentation vertebrae are fused vertebral. The most commonly involved vertebrae are the cervical vertebrae. These vertebrae are routinely visualized in CBCTs and the diagnosis is more precise in identifying non-segmentation compared to the higher percentage of the false-positive findings on lateral cephalometric radiographs. Therefore, the objective of this study was to describe the variations in cervical spine non-segmentation and manifestation on cone beam computed tomography (CBCT) images.

Methods: 50 CBCT scans with known cases of non-segmentation in the cervical vertebrae were retrieved from the archived cases database of the Oral and Maxillofacial Radiology Department. IRB approval was obtained. The subject data including age and gender were collected and the scans were assessed for the level of segmentation, the affected side, and the part of the vertebrae involved. In cases with DJD in the vertebrae the datasets were evaluated by two observers to distinguish non-segmentation from fusion of these vertebrae and a consensus opinion was reached.

Results: On these scans, the subject age ranged from 11 to 93 years old and gender distribution was 23 males and 27 females. The most common the vertebral non-segmentation was found between C2 and C3 followed by C4 and C3. Fusion between C0 (occipital bone) and C1 (atlas occipitalization) was found in two cases only. Two subjects had vertebral non-segmentation in two different regions, one in C0-C1 and C2-C3 and the other in C2-C3 and C2-C3-C4. Partial non-segmentation was more common than complete non-segmentation.

Conclusion: The congenital cervical spine non-segmentation could be easily identified in CBCT scans. These congenital anomalies might be asymptomatic and but may cause restricted movement that lead to neurologic implications. Therefore, the identification and documentation of this abnormality on the CBCT scans is highly recommended.

76. Fabrication and Characterization of 3D Nanofibrous PLLA Scaffolds for Osteogenesis

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Objective: Bone disorder incidence has steeply increased worldwide in recent decades, especially in populations of increased obesity and reduced physical activity coupled with aging. Traditionally, critically sized osteo-defects have been treated by autografts. However, harvesting of bone requires additional surgery(s) to remove tissue from the iliac crest of the patient, creating additional cost, time, and pain. To overcome this, the use of engineered scaffolding allows the regeneration of bone tissue by providing a synthetic extracellular matrix to facilitate cell regeneration. We set out to create a synthetic nanofibrous polylactic acid (PLLA) scaffolding capable of initiating osteogenesis from stem cells. Furthermore, we tested whether hydroxyapatite (HA), the main inorganic component of bone matrix, would improve cell attachment.

Methods: Three-dimensional PLLA scaffolds were fabricated using thermally induced phase separation with porogen (TIPS&P) leaching techniques. A PLLA solution was cast onto the D-fructose assemblies to create a PLLA/D-fructose composite which was transferred to a freezer at -80°C to induce phase separation, followed by freeze-drying and removal of porogen. For bioactivity assessment, scaffolds were soaked in a simulated body fluid to evenly coat HA onto the surface of scaffolds. Mouse calvaria derived pre-osteoblast cells were utilized for the *in vitro* experiments.

Results: Scaffolds were examined for morphology by SEM. For cell morphology, confocal microscopy at the Central Microscope Research Facility (CMRF) was utilized. Cells were dyed with fluorescent tags DAPI (nuclear) and Phalloidin (cytoskeletal matrix) and observed on confocal microscope to determine cell shape and penetration into scaffolds.

Conclusion: With successful pore formation in the range 300-500 µm, these scaffolds show promising potential as an environment capable of cell growth and nutrient delivery. Further research is indicated to test most efficient pore size, drug-delivery capability, and in-vitro cell differentiation. HA should be continue to be explored, as confocal imaging supported an improvement in cell attachment.

Supported by: University of Iowa College of Dentistry, Dental Student Research Program.

77. Functionalization of 3D Printed Poly (e-caprolactone) Scaffolds for Bone Tissue Engineering

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Objective: Large bony defects in the craniomaxillofacial skeleton, such as those occurring from tumor resection or trauma, remain a major healthcare concern. These defects are functionally debilitating, socially incapacitating, and biomedically and economically burdensome. Current practices attempt to restore the functionality and aesthetic appearance of such defects primarily using autografts, with limited success and recurring drawbacks, such as donor site morbidity, infection risk, and pain/discomfort. As a result, physicians, dentists, scientists, and engineers have been working to develop new substitutes for improved bone defect healing and repair. Recently, tissue engineering that utilizes 3D-printed synthetic polymers, such as poly(e-caprolactone) (PCL), has demonstrated customizable, defect-specific potential. However, unmodified synthetic scaffolds possess low bioactivity and osteointegration capabilities. Our goal was to assess if post-fabrication modifications of synthetic scaffolds with the functionalizing polymer polydopamine (PDA), and the ceramic hydroxyapatite (HA), can improve synthetic scaffold cell adhesion, cell and nutrient penetration, and osteoconductive capabilities.

Methods: 3D-printed PCL scaffolds were first generated via fused deposition modeling (FDM). They were either left as neat PCL or coated with PDA and HA via simulated body fluid. Scaffolds were seeded with mice calvaria derived pre-osteoblast cells, where they were characterized by SEM for morphological structure and by confocal microscopy with fluorescent dyes (Texas-Red X and DAPI) to observe cellular morphology and penetration after 24 hours.

Results: Ubiquitous coating of HA on 3D-printed PCL scaffolds was observed by SEM, and the confocal images illustrated improved cellular adherence and cytoskeletal spreading on post-fabrication modified scaffolds.

Conclusion: The uniform HA coating, improved cellular attachment, and observed cytoskeletal spreading all demonstrate the potential for PDA and HA to improve the bioactive potential and osteogenic capability of 3D-printed PCL customizable scaffolds for bone defect repair. Future studies may include further experimentation, quantitative testing, and the collection of quantitative data.

Supported by: University of Iowa College of Dentistry, Dental Student Research Program.

78. Opioid Prescription Trends Following Third Molar Extractions

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[1]University of Iowa, Iowa City, IA

Objective: This pilot study evaluated opioid prescriptions over a five-year period to determine how prescription trends have changed following third molar extractions.

Methods: Data was collected from retrospective chart analysis of patients following third molar extractions from January 1, 2014 to December 31, 2019. Patients were identified based on procedure codes for third molar extractions. Information obtained included patient ID, age, sex, procedure, date of visit, allergies to medications, number of third molars extracted, number of visits related to third molar extractions, and prescription details. Statistical analyses is pending.

Results: Data collection is currently taking place. Results and analysis will be complete for the local AADR presentation.

Conclusion: Results are pending final analysis, though it is expected that there has been a significant decrease in the number of opioids prescribed.

Supported by: University of Iowa College of Dentistry, Dental Student Research Program.

79. P53, Alcohol, Tobacco and Oral Cancer: a Meta-Analysis

Carissa Comnick[1], T. Peter[1], C. Pendleton[1], *E. Zeng*[1], *X. Xie*[1]

[1]University of Iowa, Iowa City, IA

Objective: The goal of this analysis is to investigate interactions between the mutation and expression patterns of the known tumor suppressor gene p53 in the tumor cells of oral cancer patients, and their tobacco and alcohol use. We conduct our investigation through a meta-analysis.

Methods: A literature search is performed with the keywords “oral cancer”, “genetics”, and “alcohol or tobacco”; 2866 papers are returned, of which 450 involve genetics and tobacco or alcohol use in human oral cancer patients. 25 papers involve p53, and 14 report counts of individuals with expression or mutation of p53 for at least one of tobacco or alcohol use. Four random effects mixed models (REMM) are used to assess the relationships between expression and mutation of p53 with tobacco and alcohol use in oral cancer patients.

Results: For each paper, the odds ratio (95% CI) of having p53 mutation (or expression) with tobacco (alcohol) use vs. non-tobacco (non-alcohol) use is given, along with an overall odds ratio and CI from the REMM. At the 5% level, no outcome of the four models is significant, though all trend toward one direction. Alcohol use is associated with lower risk of expression (95% CI .4 to 1.5) and higher risk of mutation (0.9, 2.5), while tobacco use is associated with both higher risk of expression (0.7, 5.7) and higher risk of mutation (0.7, 2.7).

Conclusion: The p53 is a well-studied gene related to many types of cancer. Through a meta-analysis, we show its mutation or expression is associated with some common risk factors in oral cancer such as tobacco or alcohol use, suggesting a further research direction for specific investigation within oral cancer patients.

80. Role of Toll-Like Receptors in Peri-Implantitis Pathogenesis

Teagan M. Byrnes[1], S. Stuhr[1], A. Sidahmed[1], G. Avila Ortiz[1], X. Xie[1], P. Galindo-Moreno[179], *S.M. Ganesan*[1]

[1]University of Iowa, Iowa City, IA; [179]Universidad de Granada, Granada, Spain

Objective: Dental implants replace teeth in at least 100 million people, yet over one million implants fail annually due to peri-implantitis. Although dental implants are estimated to have a survival rate of 95% over ten years, one in ten implants develop peri-implantitis. Peri-implantitis is a biofilm-associated pathological condition characterized by inflammation of the peri-implant mucosa and subsequent progressive loss of supporting bone. Initial sensing of microbial products in our body is carried out by the pattern recognition receptors (PRRs). The toll-like receptors (TLRs) are the best-characterized PRR subgroup and are recognized as key recognition receptors in the innate immune system. While the role of TLR in the initiation of host-response is studied in various disease conditions, the role of TLRs in the initiation of peri-implantitis has not yet been studied. Hence, we quantified the expression levels of TLRs in peri-implantitis tissues.

Methods: Tissue biopsies from twenty-four systemically healthy, non-smoking participants belonging into three groups based on clinical and histological evaluation of periodontal health: Group 1: Periodontally Healthy, Group 2: Periodontitis, Group 3: Peri-implantitis were collected, formalin-fixed, and paraffin-embedded for targeted RNA analysis. Isolated RNA was hybridized with reporter and capture probes for human inflammation panel and nCounter analysis. Quantitative data were normalized to house-keeping genes and analyzed using Ingenuity Pathway Analysis Software. TLR expression was quantified and analyzed using differential abundance analysis.

Results: TLRs on both cell membrane and endosomal membranes such as the TLRs 1, 2, 4, 6, and 9 were increased in peri-implantitis and periodontitis (greater than 2-3-fold higher) when compared to health. Peri-implantitis showed higher TLR expression than periodontitis.

Conclusion: Upregulation in the TLR genes indicates their plausible critical role in peri-implantitis pathogenesis. Differential expressions of these key pattern recognition receptors between peri-implantitis and periodontitis indicate that different molecular features may exist in the two diseases' pathogenesis.

Supported by: Osteology Foundation Young Investigator Grant.

81. Subgingival Immune Signatures of Metabolic Syndrome

Sydney M. Woods[1], A. Sidahmed[1], S. Vazana[1], M. Hakim[1], M. Petrie[1], M. Correia[1], E. Zang[1], H. Laroche[52], *S.M. Ganesan*[1]

[1]University of Iowa, Iowa City, IA; [52]University of Missouri, KANSAS CITY, Kansas City, MO

Objective: Over a billion people worldwide and more than one-third of the US adult population suffer from Metabolic Syndrome (MetS). MetS is a cluster of the most dangerous heart-attack risk factors such as increased waist circumference (central obesity), blood pressure elevation, low HDL cholesterol, high triglycerides, and hyperglycemia/insulin resistance. Evidence is emerging to show an increase in the severity of periodontitis among MetS individuals. However, the mechanism behind these associations is yet to be validated. Hence, we investigated the inflammatory milieu of the subgingival environment in MetS patients.

Methods: Gingival Crevicular Fluid (GCF) was collected from 60 subjects belonging to three groups 1) Metabolic syndrome (MetS), 2) Metabolically Benign Obesity (MBO), and Normal Weight Healthy controls (NWH). All the participants were periodontally healthy and frequency-matched for age, gender, and ethnicity. Diagnosis of MetS and MBO was based on the International Diabetes Federation. GCF was collected using filter paper strips. After GCF elution, levels of proinflammatory cytokines and adipokines were analyzed using the multiplex assay. Statistical significance was determined using ANOVA and Bonferroni corrections.

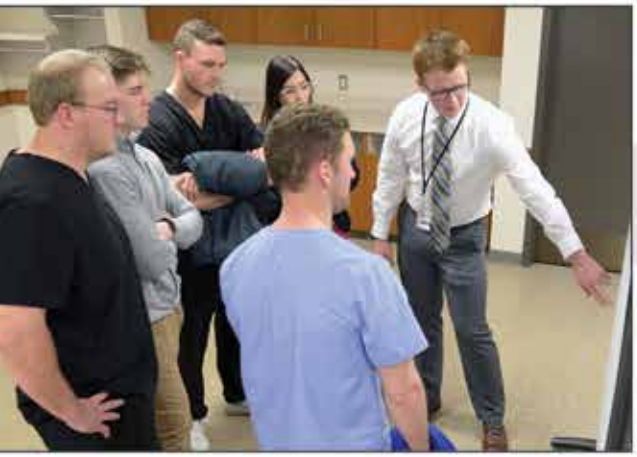
Results: The GCF of MetS and MBO groups showed a significant increase in several proinflammatory cytokines, including TNF-a, IL-1β, and regulators of inflammation such as MMP-10, when compared to NWH. Adipokines such as Leptin, Insulin, and specific obesity-related factors such as Lipocalin-2 and adipose tissue nerve growth factor (NGF) were found significantly increased in the MetS and the MBO groups when compared to NWH.

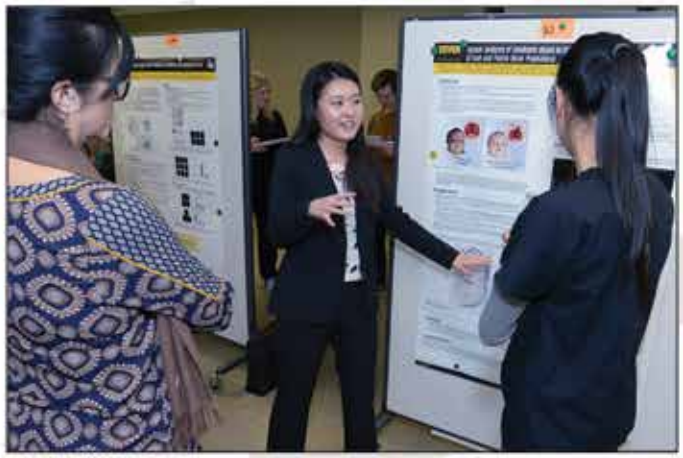
Conclusion: An increase in the proinflammatory cytokines in periodontally healthy patients with MetS and obesity indicates at-risk-for-environment before the onset of clinical disease. Identification of signature adipokines such as NGF and Lipocalin-2 and proinflammatory cytokines in GCF that mirrors the systemic levels indicate the potential use of GCF as a biomarker for MetS and Obesity.

Supported by: University of Iowa College of Dentistry, Startup Funds.

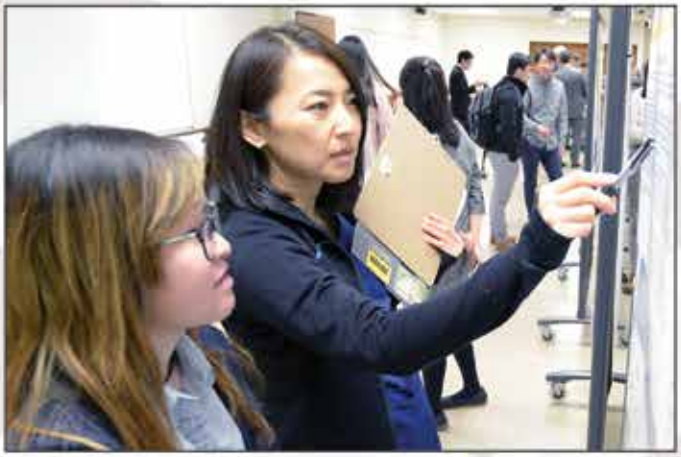
A Look Back at Research Day 2020 —

We've all made significant sacrifices for the safety and well-being of others since the 2020 Annual Meeting of the Iowa Section of the AADR. During this year's virtual meeting, those sacrifices continue, but they draw us closer to a time when we can again share exciting research with each other in person.

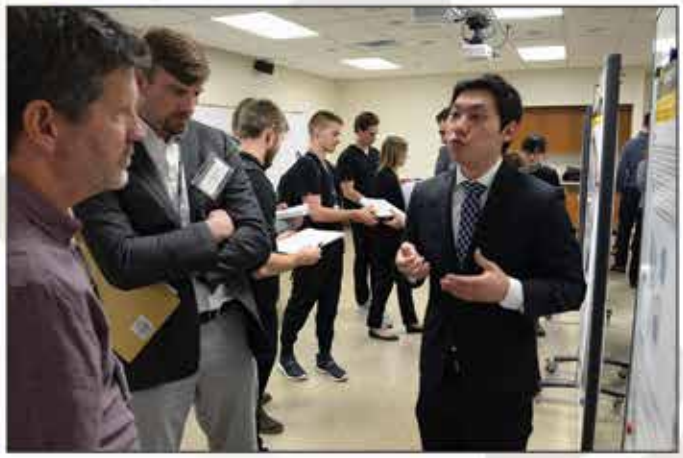








Author/Abstract-Number Index

Presenters are **underlined**.
Mentors are *italicized*.

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"Bone Regeneration" continued from page 2 —

reduce inflammation and promote endogenous bone regeneration. To address safety concerns, the research team has engineered a novel nanomaterial scaffold that mimics the bone collagen structure and delivers deferoxamine and phenamil locally and controllably.

"The drug themselves are not new and people have been using them, but we are developing a new method for controlled release of the drugs that can be delivered at a specific location," Dr. Sun explained.

These two innovations could pave the way for treatments to rejuvenate and repair significant bone damage, even for older adults. Dr. Sun and his team were recently awarded a five-year National Institutes of Health grant totaling over $1.7 million to support this research project

In a second area, Dr. Sun and his team are developing a specific bone regeneration strategy tailored to the specific needs associated with periodontitis-induced bone and tooth loss. In particular, the strategy treats the bacteria that causes periodontitis while continuously and effectively directing the body's own repair processes to the site of the damage.

Although Dr. Sun has only been at the College of Dentistry since 2018, he has had remarkable success in developing his own research and securing grant funding for his projects.

"For any major research like this, we really need a well-rounded team, with a lot of different experts from different areas," Sun explained, "and I came to Iowa because I knew I would get strong support that from other researchers, support staff, and the administration," he added.

With researchers like Dr. Sun and his team on the case, it's only a matter of time before we are making the fantasy of regrowing bone tissue a reality.

"Patient Satisfaction" continued on page 3 —

In October 2019, Hannah Klaassen, who was a third-year dental student then, presented this research project at a Noon Presentation offered to the entire college.

Dr. Mike Kanellis, associate dean of clinics at the College of Dentistry, said of the presentation, "It is very interesting and timely."

The study was published in the Journal of Dental Education in September 2020.

Klaassen's experience as a student researcher has been formative for her. She initially started conducting research because she was interested in specializing after dental school, and she didn't realize how much of an impact it would have on her.

"This research has given me an outsider and patient perspective on dentistry that I wouldn't have known, and that's invaluable," Klaassen said. She added, "I hope to continue incorporating that into my own practice going forward and analyzing patient feedback in private practices. I think there is a lot we can learn from our patients."

More broadly, the focus on research at Iowa has made a big difference for Klaassen too. Klaassen "100%" recommends that students get involved in the Student Research Program.

Speaking of her experience as an author going through an extensive review process for publication, Klaassen said, "I'm much more critical now, and I don't just accept things at face value. The curriculum at Iowa on critical thinking and research is good, but my research experience in the Student Research Program complements it very well."

And one of the biggest impacts for Klaassen has been having Dr. Marchini as a mentor.

Speaking of Dr. Marchini, Klaassen said, "There are a hundred different ways that he helped me. He gave me the skills for conducting research and publishing it, but he also gives me great advice about patients and applying research to particular cases, especially during third-year rotations and treatment planning."

Not content to rest on her laurels, Klaassen is working on another research project examining how the COVID-19 pandemic has affected dental student stress levels.

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