2019

Iowa Section of the American Association for Dental Research

66th Annual Meeting
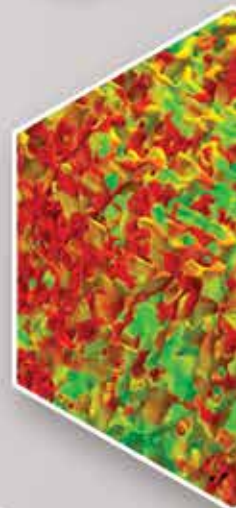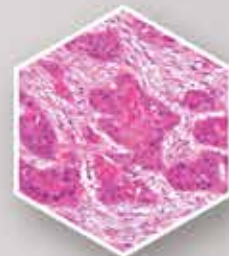
The University of Iowa | College of Dentistry and Dental Clinics

Our Keynote Speaker —

Rena D'Souza, D.D.S., M.S., Ph.D.

Rena D'Souza is Professor of Dental Sciences, Neurobiology and Anatomy and Pathology. She currently serves as Assistant Vice President for Academic Affairs and Education for the Health Sciences. As a clinician-scientist, D'Souza has been strongly committed to discovery and mentoring throughout her academic career. She is a past president of the American Association for Dental Research (AADR) and the current President of IADR, a global organization of over 11,000 members from over 100 countries.

Dr. D'Souza has authored over 150 publications and book chapters and has maintained an active research program for over 30 years through grant awards from the National Institutes of Health and other agencies. She has also led two major NIH-funded institutional grants that supported the research training of dentists and dentists-scientists at the predoctoral and postdoctoral levels. She received the 2002 Distinguished Scientist Award from the International Association for Dental Research (IADR) and the Presidential Award for Research Excellence from the Texas A&M Health Science Center in 2010. She was also inducted into the German National Academy of Sciences in 2012. Dr. D'Souza was recognized as the Columbia University College of Dental Medicine's Birnberg Research Medal in 2016. Dr. D'Souza was nominated as Fellow of the AADR and received its 2017 Irwin D. Mandel Distinguished Mentoring Award.

Keynote Address:

Visions for the Future of Dental, Oral and Craniofacial Research

We live in a golden era of biomedical sciences when the convergence of science and technology advances offer us a far deeper understanding of the biological mechanisms underlying human health and disease than ever before. Knowledge derived from DNA sequencing and genomics, imaging, bioinformatics and the mining of "Big Data" are now driving novel precision medicine initiatives for individualized therapeutics, neurosciences and cancer biology. The rapidly changing scientific landscape demands the creative use of integrative and cross-disciplinary approaches that will create tangible therapies for improving human health. This talk will highlight IADR's success in leveraging such opportunities to advance dental, oral and craniofacial research and improve oral health for all. The concluding segment will describe recent findings that evaluated the efficacy and safety of small molecule replacement therapies for the correction of secondary palatal clefts in mouse genetic models. Application of such precision-driven approaches offer new paradigms for the treatment of human disorders of single gene origin and for which there are currently no cures. [This project is supported by NIH/NIDCR Grants DE019471 and DE027255 to RDS].

Dental research images for the cover were selected from poster submissions for AADR Research Day 2018. Thanks for these images go to Rawa Alammari; Colby Beck; Alberto Gasparoni; Steve Levy; and the Department of Oral Pathology, Radiology, and Medicine.

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Research at our College

Research Day 2019

Academic-Industry Collaboration Customizes Cancer Treatment

We are all as unique as our fingerprints. When squamous cell cancer of the head and neck strike—as they do on average 51,000 times each year—we need treatments tailored for our specific genetic makeup.

Dr. Kim Brogden, professor in the Department of Periodontics, and director of the Iowa Institute for Oral Health Research, and his research team are tackling this head-on in partnership with a precision medicine company, Cell-Works, Inc., to identify the best available treatments for genetic variations of squamous cell cancers.

"We would know which treatments are likely to be ineffective, and we can avoid subjecting patients to severe side-effects, including autoimmune diseases, inflammation, and infection. Going forward, we may even be able to prevent cancer with these models."

For each genetic variation, "CellWorks creates a data set including each signal and cell pathway from stimulus to output, and this data set is used to create a computational model of the cell," Brogden said. "This model can then identify how cells with different mutations respond to treatment."

The problem, however, was that CellWorks needed to ensure that their model was accurate. That's where the collaboration with Brogden's lab began.

CellWorks would provide a computational model that the Brogden lab would validate. The lab would collect tumor cell lines with the same genetic makeup as the model, culture those cells, and determine whether those cells responded to treatment as predicted.

According to Dr. Shireen Vali and Taher Abbasi, the cofounders of Cellworks, Brogden's lab work has greatly improved their model's predictions and has been "... key to establishing a precision medicine computational workflow which takes patient DNA/RNA information as inputs and personalizes treatment."

The models were validated in 80 to 90 percent of cases, and because of this research, oncologists have a new tool for determining the best treatment for a patient based on the specific genetic makeup of the patient's tumor, rather than using a trial-and-error method that has a success rate of only 25 percent.

"We would know which treatments are likely to be ineffective," Brogden said, "and we can avoid subjecting patients to severe side-effects, including autoimmune diseases, inflammation, and infection. Going forward, we may even be able to prevent cancer with these models."

The end goal is to develop a holistic system of computational models that would learn and adapt as new scientific information is added.

"We often think of science as a linear progression, but with the breadth of research being conducted today it can be hard to see science that way," Brogden said.

The hope is that these models can help restore that linear progression, taking all of that information, organizing and making sense of it so that it can inform decision-making and clinical outcomes.

The progression of science, however, is not just about research, it also requires that we train the next generation of scientists. And that's what Brogden is most proud of in his career. One of his greatest accomplishments at the University of Iowa, he says, is that of the 68 articles he's published during his 15 years at the University of Iowa, his students have been the first author of 45 of them, and nine of them had four or five students as authors.

Dr. Teresa Marshall, the director of the Dental Student Research Program, speaks glowingly of Brogden's excellence as a mentor.

"His students are well trained and function together as a team," said Marshall, which allows them "to generate high quality research, which makes them very competitive for local and national awards," she added.

Dr. Amber Bates and Dr. Paula Gomez Hernandez are two such students. Bates just defended her dissertation last spring after working in Brogden's lab for five years, and she is now a postdoctoral research associate in a cancer research center at the University of Wisconsin.
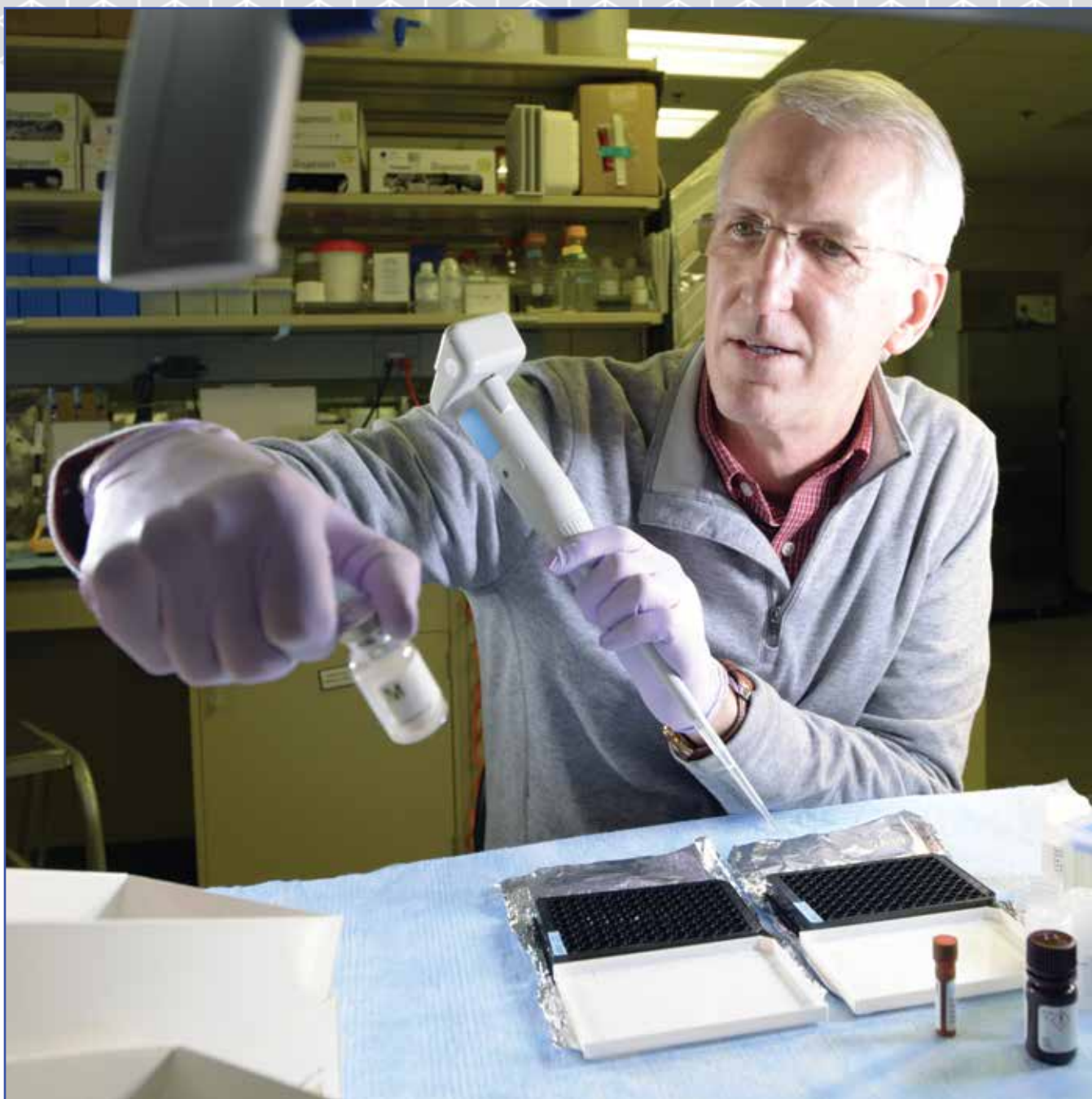
Dr. Kim Brogden's lab conducts cutting-edge precision medicine research.

"My research on head and neck cancer in Dr. Brogden's lab is what led me to become interested in cancer research," Bates said.

Brogden, Bates said, "... is the type of mentor that everyone wishes they had, but are actually quite hard to find. Dr. Brogden realizes the benefits of transferrable skills and encourages his students to become effective communicators and develop a range of laboratory skills."

Training the whole person—as a researcher, scientist, communicator, writer, and team member—is a hallmark of Brogden's approach.

"Amber Bates is a great sign of success," Brogden said as he beamed with pride. "Sending her on to an elite cancer research center shows what an excellent researcher she's become."

The Role of Oral *Streptococci* in the Early Stages of Dental Decay

Some things just go together! Peanut Butter and Jelly. Batman and Robin. Banas and Drake.

Dr. Jeff Banas is a professor of microbiology in pediatric dentistry and the Iowa Institute for Oral Health Research and the director of graduate studies for oral health science. Dr. David Drake is a professor of microbiology in endodontics and the Iowa Institute for Oral Health Research. With strong rapport and over a decade of collaboration, these two researchers have become known for their work together on the cariogenic roles of oral *Streptococci* and the oral microbiome.

"When one of us presents our research, most people just assume that the other was involved in the project," said Drake with a chuckle.

Their work together was rewarded in 2018 when the National Institutes of Health awarded them a five-year $2.6 million grant. For this project, Banas and Drake are examining young children with a high risk of early childhood tooth decay for a particular kind of plaque bacteria, *Streptococci*.

"The hypothesis for decades has been that certain plaque species have unique acidic properties, particularly *Streptococcus mutans* and *sobrinus*, and these are responsible for a large proportion of dental decay, but other low-pH plaque species may blaze the trail for these bad species of *Streptococcus*," Banas explained. Although this has been the theory, there is sparse evidence for the roles of highly acidogenic (low pH) streptococcal species besides *S. mutans* and *S. sobrinus*.

"We will be able to see how the low pH populations fluctuate and shift the microflora, which helps the bad species of Streptococcus become more dominant, especially for children with high-sugar diets."

That's where Banas and Drake come in. During preliminary investigations on banked plaque samples, they isolated two common streptococcal species that were among those thought to possess the low pH phenotype that

Dr. Banas and Dr. Drake discuss their study with research assistant Alissa Villhauer and research specialist Dr. Min Zhu.

can make the oral microbiome a more suitable environment for the tooth-decay-causing species of plaque.

"The problem was that the various species die at different rates in the frozen state, so the banked samples were less than optimal," said Banas.

As a result, Banas and Drake decided to propose and were awarded a grant for an 18-month longitudinal study of 130 children between the ages of 1 and 3, many of whom have a high risk of dental decay. Each participating child will be examined four times over the course of the study so that the team can track the changes in the low pH streptococcal population as well as other changes in the plaque microbiome.

"We will be able to see how the low pH populations fluctuate and shift the microflora, which helps the bad species of *Streptococcus* become more dominant, especially for children with high-sugar diets," Drake said.

Then, the team will sequence the genome of specific low pH species of *Streptococcus* that were identified in their longitudinal study.

Although the relationship between tooth decay and the oral microbiome is complex, learning more about the specific genetic and phenotypic characteristics of the various species could improve prevention and treatment options. "If we understand the disease process better and can isolate key variables, we might be able to prevent it or treat it early on," Drake said. "Or even establish a new standard for risk assessment," Banas added as he finished Drake's sentence.

And that would be an important step for improving oral health. "Once the disease process begins, it can be stopped but it is much more difficult after the microbiome has been transformed." That's one reason why it's so important for parents to take their children to the dentist at a young age.

Knowing the makeup of the oral microbiome could have other long-lasting implications. For example, prebiotics and probiotics could be designed to help good bacteria in the mouth

Left to right: Dr. Jeff Banas, Dr. Min Zhu, Alissa Vilhauer, and Dr. David Drake

while preventing bad forms from flourishing. "Prebiotics could feed the good guys, just as sugar feeds the bad guys," Drake quipped.

As Banas and Drake embark on another research project together, each of the two has really come to appreciate what the other brings to the table. "We really work well together; we are much stronger together than we are individually," Banas said. "It's so important to see things from other perspectives, and this type of collaboration helps us leverage our talents to get even more support," Drake added.

From the Bench to the Chair:

Translational and Clinical Research at the College of Dentistry

Dental researchers at the college have a strong history of pursuing basic, clinical, and translational research in a collaborative and supportive environment with the goal of improving patient care. "The ultimate goal of our research is to benefit and contribute to our community and society," said Dr. Cristina Vidal, assistant professor in operative dentistry.

The college's translational and clinical research has flourished by drawing knowledge and experience from College of Dentistry colleagues and other disciplines—from medicine to physics, from public health to engineering.

> *"The ultimate goal of our research is to benefit and contribute to our community and society."*

"Many questions in dentistry can be addressed, at least in part, with advances that have been made in other fields such as medicine or engineering. So I often start by asking 'What approaches are being used in other fields?'" said Dr. Kyungsup Shin, assistant professor in orthodontics and director of clinical research for the college.

For example, in the field of Oral and Maxillofacial Radiology, clinical professor Dr. Trishul Allareddy has been using his expertise to improve the quality of dental radiographic images as the co-chair of the Standards Committee on Dental Informatics for the American Dental Association and Co-Chair of DICOM international standard for Dentistry.

"Most of the 180,000 US dentists make radiographs in their offices, but they have minimal training in radiology in dentistry and often the scope of that training does not address quality assurance across all modalities of imaging in dentistry," said Allareddy, "and that's why it is so important to know how things should be done."

Having high-quality images requires a goldilocks level of radiation—just enough to get sufficient information for clinical judgments, but not too much, which exposes the patient to too much radiation.

"Unfortunately, many of the digital intraoral radiographs that dentists take are not clinically useful as the patients are underexposed and the radiographs do not have enough information," Allareddy explained.

In addition to creating standards for the use of x-rays in dental clinics, Allareddy is also researching best practices for the use of cone-beam computed tomography (CBCT) in dentistry. CBCT technology is used when regular dental radiographs are not sufficient—for example, in cases of oral cancer or for dental implants.

"Dentists need to be aware of what imaging tools are useful in which contexts; it's really about optimizing our care for each patient," Allareddy said.

That's also a central part of Vidal's research. Whether designing materials that will take less time to use or discovering bioactive materials and mechanisms that can stimulate and regenerate teeth, Vidal's research is focused on patient well-being.

Two of Vidal's recent projects illustrate this line of research. In one, she is investigating a novel universal bonding agent that doesn't require any light curing—and thus, it could reduce the time a patient spends in the dentist's chair. Her research team will determine how well this new agent performs and make recommendations for its use in clinics.

In another, her team is exploring how a certain plant-derived compound that can preserve, repair, and restore the bond between dentin and resin material.

Although these particular clinical applications are important, Vidal is also interested in the underlying mechanisms. "By understanding both the enzymes that degrade collagen, and the natural processes that inhibit degradation of the resin-dentin bond, we will have a greater understanding of the most efficient and least invasive approaches in the clinic," Vidal said.

Like Allareddy and Vidal, Shin's research—specializing on the temporomandibular joints

(TMJ)—exemplifies the college's patient-oriented and collaborative research.

After asking about approaches in related fields, Shin found out that an orthopedic research group (Dr. Don Anderson) had used medical CT images of leg fractures to determine the risk for developing arthritis as a result of the fracture. Shin wanted to apply that research to his specialty, the TMJ.

Drawing on Allareddy's expertise in radiology and CBCT images, Shin hopes to develop a predictive diagnostic tool using CBCT images to assess the risk of developing osteoarthisis in the TMJs after trauma to the joint. Post-traumatic osteoarthritis in this joint is particularly challenging to treat, often requiring extensive surgical procedures.

"Without reliable predictive diagnostic tools, we don't really know when to intervene to prevent long-term complications associated with post- traumatic osteoarthritis," Shin explained.

Shin has also been collaborating with colleagues in other colleges—Dr. Aliasger Salem in pharmacy and Dr. James Martin in medicine—on basic science research concerning bone and cartilage tissue regeneration in the TMJ.

Allareddy, Vidal, and Shin are wonderful pictures of the collaborative, translational and clinical research being conducted at the College of Dentistry. Whether patients are having a dental radiograph made, having a broken tooth repaired, or having surgery on their temporomandibular joint, these researchers are finding a way to make a difference.
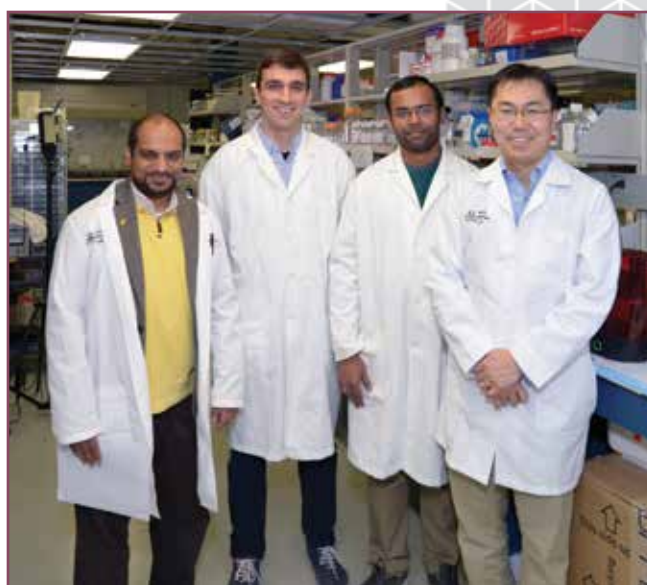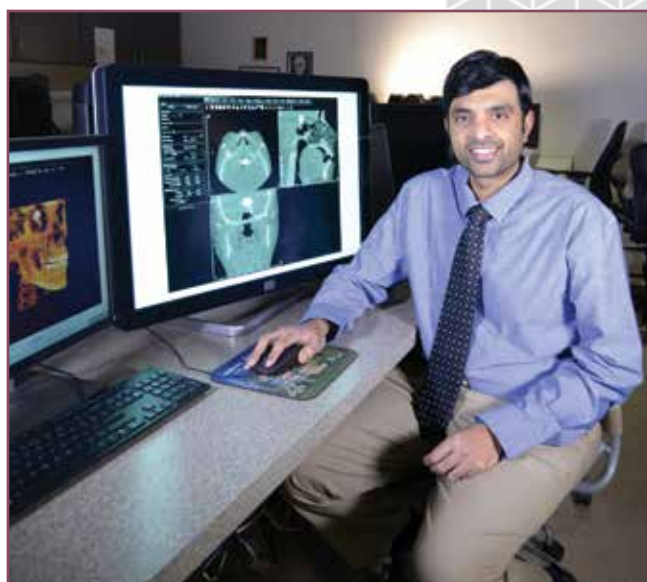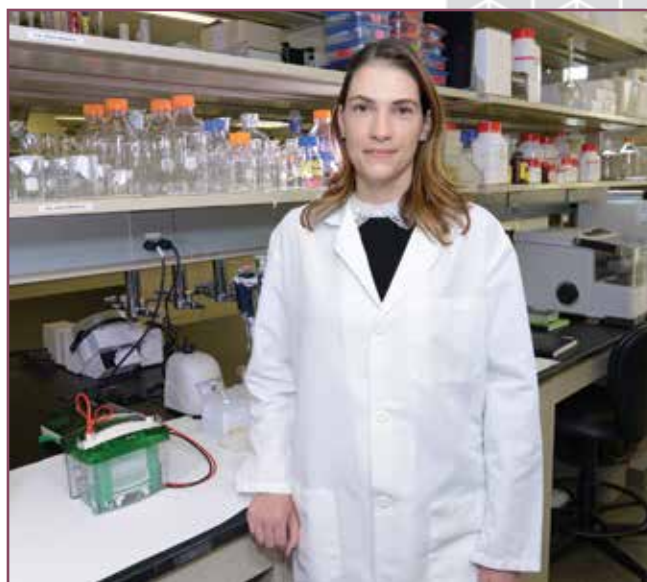
Photo, top:
Dr. Cristina Vidal is researching ways to restore and regenerate teeth.

Middle::
Dr. Trishul Allareddy is an expert in radiographs and their use in dentistry.

Bottom:
Left to right: Dr. Aliasger K. Salem, PhD student Timothy Acri, Postdoctoral Fellow Dr. Leela Raghava Jaidev Chakka, and Dr. Kyungsup Shin.

A World-Class Program for Biostatistics and Computational Biology

The faculty and staff for the Division of Biostatistics and Computational Biology regularly meet to discuss how they can best serve the research needs of the college.

From baseball to politics, big data has taken the world by storm. It has revolutionized our recreational pursuits and our health care decisions. Oral health research is no exception to this trend, and the College of Dentistry is on the cutting edge of that trend.

The Division of Biostatistics and Computational Biology provides statistical and computational expertise for the college's research projects. Although in past generations statistical analysis was mostly performed by an individual researcher, it is now an expectation that elite biomedical research centers have a designated biostatistics division.

"We are the first college in the country to have a division of biostatistics and computational biology."

"A single person is simply not adequate anymore. The databases are too large and of great complexity, and any person would have to know database management, frequentist methods, Bayesian methods, bioinformatics, structural equation modeling, etc.," said Dr. Xian Jin Xie, director of the Division of Biostatistics and Computational Biology.

Xie joined the college a little over a year ago in fall 2017, and since then, his division has worked with over 40 researchers at the col-

lege. Xie has really appreciated the collegial working environment. "Everyone is so easy to work with and the faculty really support one another," said Xie. "This environment really lays the foundation for achieving more NIH grants, and potentially large multi-investigator program grants," Xie added.

Xie also underscored how much support he's received from the college administration. "We have received great support from Dean Johnsen, Dean Schneider, and Dean Amendt. Everything we've asked for, they've given us."

And Xie has asked for a lot! Ultimately, he aims for the division to become a model for dental colleges across the country. "We are the first college in the country to have a division of biostatistics and computational biology," Xie said. This new methodological focus is poised to become the new standard.

Xie's first year plan had three goals for accomplishing that ambitious goal.

First, he sought to recruit high quality faculty and research staff, like associate professor Dr. Erliang Zeng, a new faculty member in the division who specializes in bioinformatics. Adding Zeng was crucial for establishing the division's expertise in computational biology.

Second, he wanted to continue building on the college's grant writing success, and his

division has helped with 10 NIH grant submissions and many foundation sponsored grants this past year.

Third, he plans to develop educational modules and one-hour lectures to help improve knowledge of statistical methods with the aim of helping all of our researchers, but especially our clinical researchers who want to do research but have limited time because of their extensive clinical responsibilities

Although a great deal of Xie's attention is dedicated to serving as the director of the division and advising on dental research projects, he also conducts and publishes his own

statistical research on 1) statistical model diagnosis; 2) high throughput data analysis; and 3) a new design of Phase I Clinical trials.

"In my position, you need a breadth of knowledge to support various basic science and clinical research projects, but it's always fulfilling and enjoyable to have your own research too," said Xie.

The Division of Biostatistics and Computational Biology is located on the first floor of the north wing of the Dental Science Building and is available for consults for upcoming research projects.

The University of Iowa College of Dentistry Division of Biostatistics and Computational Biology (BCB) supports research at the College of Dentistry in each of the following ways

- conducting preliminary data analysis and assisting in research hypothesis formulating.
- reviewing background rationale and providing statistical design and analysis plans required to address the specific aims of clinical protocols, translational and basic science research projects.
- providing proper analysis and interpretations of data collected from bioassays, drug screening, animal models, clinical investigations, and population-based studies.
- assisting in manuscript preparation and reviewing scientific submissions.
- critically reviewing and advising on clinical protocols conducted at College of Dentistry.
- providing database development and computer programming services and assuring data quality control.
- providing general statistics and bioinformatics consultations for all College of Dentistry investigators.
- providing special education and training opportunities (lectures and lab meeting discussions) in biostatistics and bioinformatics to students, residents, fellows and junior faculty investigators.
- conducting quantitative methodological research that is directly applicable in dental science..

Dear Colleagues:

Thank you for your participation in the 66th Anniversary of the University of Iowa College of Dentistry's Local Research Day on February 12, 2019. Research is central to our mission and is important in itself and for the culture of inquiry that it supports. This day is one of the highlights of our life as an academic community. The event's planning committee and research presenters are to be heartily commended for their hard work.

We are honored to host Dr. Rena D'Souza as our keynote speaker. Dr. D'Souza is Professor of Neurobiology, Pathology, and Medicine and the Associate Vice President of Research at the University of Utah School of Medicine. As an outstanding scholar, leader, and mentor in our profession, she has held and continues to hold many prominent positions at her university and in the wider profession, including serving as President of the International Association for Dental Research, the 41st President of the American Association for Dental Research, and many other prominent positions related to oral health. We are excited to continue building our relationship with Dr. D'Souza.

Our College has been very successful in recruiting very bright and talented faculty in the past few years. 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. It is an exciting time for the College's future!

Local Research Day shows the people and the spirit of discovery that have always made possible outstanding education, service, research, and patient care within our College.

The presentations today and this research abstract book offer many opportunities to learn about fascinating research within our College. Thank you for being a part of this important event.

Best wishes,

David C. Johnsen, DDS, MS
Dean

February 12, 2019

Dental Research participants and Iowa Section of the American Association of Dental Research (AADR):

The University of Iowa College of Dentistry and Dental Clinics (CoD) and the Iowa Institute for Oral Health Research (IIOHR) are committed to advancing science in our laboratories and clinics. Science in the clinics and research laboratories is focused on several thematic areas for the improvement of oral health and patient care. Interdisciplinary collaboration between CoD scientists and other Iowa researchers is essential to the training of future dentists and dental researchers.

The Iowa AADR symposium represents a commitment to recognize the current research programs that exist at the CoD and all the great research accomplished over the last year. Our students, post-doctoral associates, residents, faculty and staff have worked together in the discovery of new and novel scientific paradigms. Dental research covers all aspects of basic, clinical and evidenced-based research studies, often combining multiple disciplines.

In 2018, the CoD successfully recruited several new faculty members whose expertise covers bioinformatics and computational biology, tissue and bone engineering, craniofacial biology, periodontal health, and diabetes-related research. All the new faculty have Federal funding and contribute to clinical translational science. The goal is to provide the resources required to improve research at the College and develop new partnerships and collaboration across the University research community. New infrastructure has been added to facilitate the work of all of our researchers and students. We are grateful the College's NIH T90/R90 training program is continuing, which has been funded for over 30 years.

The Biostatistics and Computational Biology faculty use Big Data (AxiUm and EPIC patient data) to ask questions regarding disease prediction and precision medicine. We are at the forefront of new technologies and machine learning that will move patient care to a new level.

This year we are honored to have Dr. Rena D'Souza, DDS, MS, PhD as our keynote speaker. Dr. D'Souza is the current President of the International Association for Dental Research, and she was the 41st President of the AADR (2012-2013). She is a Professor of Neurobiology, Pathology and Surgery and the Associate Vice President of Research at the University of Utah School of Medicine. Dr. D'Souza is an outstanding researcher and administrator, and she has mentored many students and post-doctoral researchers. In 2017, she was awarded the AADR Irwin D. Mandel Distinguished Mentoring Award. She is a friend to many at Iowa and a global leader in dental research and education.

Warmest Regards,

Brad A. Amendt, PhD
Associate Dean for Research
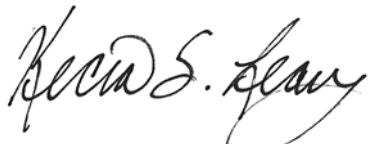
Kim Brogden PhD
Director, IIOHR

Dear Colleagues,

On behalf of the Iowa Section of the American Association for Dental Research (AADR), we are very pleased to welcome you to the University of Iowa, College of Dentistry & Dental Clinics Annual Research Day.

This is the 66th edition of the Annual Meeting of the Iowa Section of the AADR, which provides an open forum for colleagues and students to present their exciting research findings and accomplishments to members for the larger research community. Findings range from basic, translational, clinical health, quality assurance/improvement, policy and services research, and they underscore the breadth of investigations taking place within our college. The annual meeting represents a unique moment each year to observe and invigorate the research conducted by all of the people at the College of Dentistry.

We are honored to have Dr. Rena D'Souza as the keynote speaker. Dr. D'Souza is a Professor of Dentistry at the University of Utah. She is the Past-President for the American Association for Dental Research and is current President of the International Association for Dental Research. She has been instrumental in her research in craniofacial development, genetics, tooth development and regenerative dental medicine. More importantly, she spends time mentoring new research scientists. Dr. D'Souza's keynote address is titled "Visions for the Future of Dental, Oral and Craniofacial Research."

Overall, 103 research activities will be presented in various formats at our annual meeting this year. We would like to thank the presenters, mentors, judges, and staff for their participation and support in making this event successful. We also thank our colleagues from Chongqing Medical University for their research collaboration with our College and for participating in the event. Finally, we would like to thank all of the sponsors who have generously contributed to the Local AADR Research Day. Their contributions are essential to our success.

Sincerely,

Kecia Leary, DDS, MS
President, Iowa Section of the AADR
Associate Professor (Clinical)
Department of Pediatric Dentistry

Cristina Vidal, DDS, MS, PhD
Vice President, Iowa Section of the AADR
Assistant Professor
Department of Operative Dentistry

Sharon K. Seydel
Secretary/Treasurer, Iowa Section of the AADR
Department Administrative Manager
Iowa Institute for Oral Health Research

The University of Iowa, College of Dentistry and Dental Clinics welcomes our visitors from Chongqing Medical University, School of Stomatology, Chongqing, China for the 2019 Local AADR Research Day.

Milestones of Achievement

- The Dean of Chongqing Medical University, School of Stomatology (Dr. Ping Ji) and Administrators invited faculty from the UI College of Dentistry to visit Chongqing and establish a Memorandum of Agreement—To collaborate for the Advancement of Oral Health Research and Scholarship in Oral, Craniofacial and General Health—September 2016

- The Dean of the University of Iowa, College of Dentistry (Dr. David C. Johnsen) invited faculty from Chongqing Medical University, School of Stomatology to visit Iowa and meet our faculty and discuss research, teaching and training opportunities—May 2017

- Faculty and colleagues from Chongqing presented their research at the University of Iowa 2018 Local AADR Research Day. This event is a first for the UI College of Dentistry and Chongqing Medical University School of Stomatology and strengthens our commitment to encourage an exchange of ideas, research, teaching and training opportunities for all of our faculty and students—February 2018

- 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 Iowa and Chongqing faculty. We have started several research projects and collaborations with Chongqing faculty—May 2018.

We are pleased to welcome our Chongqing collaborators to the UI Local AADR Research Day held February 12, 2019. We are advancing our exchange of ideas, research and education, which strengthens Oral Health global initiatives at the University of Iowa and Chongqing Medical University, School of Stomatology.

Program

Iowa Section of the American Association for Dental Research (AADR)
66th Annual Meeting, Tuesday, February 12th, 2019

7:30 a.m.	**Reception with Coffee and Rolls** (1st Floor)
8:00 a.m.	**Welcome Address** (Galagan A/B/C) Dr. David Johnsen and Dr. Brad Amendt **Keynote Speaker Introduction** Dr. Kecia Leary
8:20 a.m.	**Keynote Address** Dr. Rena D'Souza *"Visions for the Future of Dental, Oral and Craniofacial Research"*
9:20 a.m.	**Break**
9:30 a.m. - 11:45 a.m.	**Oral Presentations** Session One (Galagan A) Session Two (Galagan B) Session Three (Galagan C) Session Four (Oral-B Classroom N212) Evidence-Based Research Session (Margeas Classroom W205)
11:45 a.m. – 12:45 p.m.	**Poster & Table Clinic Presentations** (Iowa Institute for Oral Health Research, W220 A/B)
5:00 p.m.	**Awards Banquet Reception with Cash Bar** (Radisson Hotel & Conference Center, Coralville)
6:00 p.m.	**Awards Banquet Dinner & Awards** (Radisson Hotel & Conference Center, Coralville)

Presentation Assignments

Oral Session 1

9:30 a.m. - 11:45 a.m., Galagan A

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- (a) Max Smith Pre-Doctoral Competition
- (b) Max Smith Oral Health Science Graduate Competition
- (r) Basic Science Post-Doctoral Award
- (u) International Basic Research Faculty/Post-Doctoral Award

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1.   **<u>Steven L. Eliason</u>**, Y.Y. Sweat, C. Chalkley, H. Xu, H. Cao, K.A. Brogden, L. Hong, *B.A. Amendt*

   A Proposed Use of miRNAs and miRNA Inhibitors as Potential Therapies for Tumors

2. [u] **<u>Jie Xu</u>**

   Potential Therapeutic of IL-37 in TMJ Inflammation: A Key Suppressor of Inflammation Required IL-1R8 Mediated by Inhibits the p38 and ERK MAPKs Pathways

3. [u] **<u>Yu Yang</u>**, L. Liao, B. Shao, X. Su, S. Yi, H. Wang, F. Shang, Z. Zhou, D. Yang, Y. Jin

   Knockdown of MicroRNA Let-7a Improves the Functionality of Bone Marrow-Derived Mesenchymal Stem Cells in Immunotherapy

4. [a] **<u>William J. Burns</u>**, M. Romero-Bustillos, T. Sharp, *B.A. Amendt*

   Cell Media Components From Reprogramed Odontoblast Cells Activate Epithelial Specific Genes in Wildtype Cells

5. [b,r] **<u>Matthew T. Remy</u>**, A. Akkouch, L. He, M.E. Sweat, F. Qian, X. Song, B.A. Amendt, *L. Hong*

   Novel microRNA-Incorporated 3D-Printed Scaffolds for the Treatment of Critical-Sized Bone Defects

6. [b,r] **<u>Yan Y. Sweat</u>**, W. Yu, Z. Sun, M.E. Sweat, S.L. Eliason, *B.A. Amendt*

   Ablation of Sox2 in the Developing Oral Epithelium Results in Cleft Palate and Ankyloglossia

7.   **<u>Min Zhu</u>**, S.L. Eliason, *B.A. Amendt*, *L. Hong*

   Developing miR-enriched Exosomes As a miR-based Gene Therapy for Obesity-Associated Periodontitis

8. [b,r] **<u>Waheed O. Awotoye</u>**, S. Gupta, T. Busch, J.V. Park, A. Dear, T. Reid, C. Buxo, *A. Butali*

   Targeted Sequencing of *Mrpl53* Identify Rare Missense Variants That Are Associated With Orofacial Clefts in Multiple Populations

9.   **<u>Long Jiang</u>**, T. Krongbaramee, M. Zhu, *L. Hong*

   Upregulation of microRNA-126 Enhances the Angiogenesis and Inhibits the Inflammatory Response in Dental Pulp Inflammation

Oral Session 2

9:30 a.m. - 11:45 a.m., Galagan B

- (a) Max Smith Pre-Doctoral Competition
- (b) Max Smith Oral Health Science Graduate Competition
- (g) Endodontic Michel Fuller Post-Doctoral Award
- (i) Iowa Society for Periodontology Post-Doctoral Award
- (r) Basic Science Post-Doctoral Award
- (u) International Basic Research Faculty/Post-Doctoral Award

10. **Emma L. Thayer**, K.A. Brogden, *K.A. Morio*

   255 nm Light Emitting Diode (LED) in Combination With Bleach (NaClO) Is More Effective in Killing E. faecalis in Root Canal Therapies

11. [u] **Yuejia Deng**, M. Tan, J. Song

   Low-Intensity Pulsed Ultrasound Suppress the Inflammation of Periodontal Ligament Cells From Periodontitis Patients and Enhance the Osteogenic Differentiation through Endoplasmic Reticulum Stress Pathway

12. [a] *X. Chen*, **Nathan. T. Goodson-Gregg**, *F. Qian*

   Identifying Dental Pain Behaviors in Older Adults With Dementia: A Preliminary Study Using the Delphi Technique

13. [b,g] **Jered J. Vislisel**, L.R. Jaidev Chakka, M. Tillman Biz, C. Vidal, A. Salem, *B. Cavalcanti*

   Application of Gene-Activating BMP-2/FGF-2 Collagen Scaffolds for Dental Pulp Capping

14. [b,r] **Tadkamol Krongbaramee**, L. Jiang, M. Zhu, F.B. Teixeira, *L. Hong*

   Dentin Regeneration by a Novel microRNA

15. [u] **Fengyi Liu**, S. Yang, P. Ji

   Evaluation of Photo-Crosslinked PAMAM/GelMA Hydrogel for Bone Regeneration

16. [b,i] **Miguel Romero-Bustillos**, S.L. Eliason, *G. Avila Ortiz*, *B.A. Amendt*

   Insulin-Like Growth Factor 1 Receptor Plays a Role in Enamel and Root Development

17. [b,r] **Mason E. Sweat**, Y. Guo, *B.A. Amendt*, *H. Cao*

   Mapping the Lower Incisor Stem Cell Niche With Single Cell Resolution

18. [a] **Katelyn Stine**, P. Scaffa, M. Carrilho, *C. Vidal*

   MMPs Extraction Assay and Enzymatic Profile in Carious Lesion Progression

Oral Session 3

9:30 a.m. - 11:45 a.m., Galagan C

....

(a) Max Smith Pre-Doctoral Competition
(b) Max Smith Oral Health Science Graduate Competition
(o) Pediatric Dentistry Post-Doctoral Award
(u) International Basic Research Faculty/Post-Doctoral Award

........▼..

19. **Alexandria C. Cashmore**, *X. Chen*, A. Welhaven, X. Xie

   Development of a Cognitive Screening Assessment for Dental Practitioners

20. [u] **Yihan Li**, D. Li, P. Ji

   Programmed Dual Delivery Hierarchical Scaffold Coatings Eradicate Biofilms and Accelerate Bone Tissue Repair Partly through Osteoimmunomodulation

21. **Ahmed Mahrous**, G.B. Schneider

   Enhancing Student Learning of Removable Prosthodontics Using the Latest Advancements in 3D Modelling

22. X. Chen, **Daniel. J. Caplan**, A. Welhaven, X. Xie

   Identifying Nursing Home Residents at the End of Life in Dental Settings

23. **Raymond A. Kuthy**, S.C. McKernan, J.C. Reynolds

   Iowa Dentist Tracking System: 20 Year Highlights

24. **Xi Chen**, V. D'Souza, S. Gilbertson-White, T. Thomson, J. Madiloggovit, C. Pendleton, X. Xie

   Oral Health Needs and Perceptions of Seriously-ill Persons Receiving Palliative Care

25. [b,r] **Aline L. Petrin**, W. Lyu, P.A. Romitti, M.M. Jenkins, R.G. Munger, J.C. Murray, A.J. Wilcox, R.T. Lie, G.L. Wehby, *L.M. Moreno Uribe*, N. National Birth Defects Prevention Study

   A Population-based Study of Gene x Smoking Interactions and Orofacial Cleft Risk

26. [a] **Frankie Chyi**, *J.J. Warren*

   Factors Associated With Toothpaste Use Among Low-Income Families

27. [b,o] **Alison R. Christensen**, *D.V. Dawson*, K. Weber-Gasparoni, A.I. Owais

   Early Childhood Caries Among Premature Children Enrolled in WIC: A Twenty-Year Retrospective Study

Oral Session 4

9:30 a.m. - 11:45 a.m., Oral-B Classroom N212

....
- (b) Max Smith Oral Health Science Graduate Competition
- (g) Endodontic Michel Fuller Post-Doctoral Award
- (i) Iowa Society for Periodontology Post-Doctoral Award
- (j) Operative Dentistry Post-Doctoral Award
- (p) Preventive & Community Dentistry Post-Doctoral Award
- (r) Basic Science Post-Doctoral Award
- (v) International Clinical Research Faculty/Post-Doctoral Award

....

28. [v] **Jianping Zhou**, J. Chen

    The Effect of Stabilization Splint Therapy to Bone Remolding of Condylar Resorption in Juvenile Patients

29. [b,r] **Ronilo J. Ragodos**, T. Wang, G.L. Wehby, S. Weinberg, D.V. Dawson, M.L. Marazita, L.M. Moreno Uribe, *B.J. Howe*

    Dental Anomaly Image Classification Using a Convolutional Neural Network

30. [b,j] **Arwa A. Alhakami**, C. Vidal, F. Qian, T.A. Marshall, *R. Rocha Maia*

    Effect of Time and Temperature on Color Stability of Dental-Composite

31. [b,g] **Mikaela Hazard**, C. Wicker, *F.B. Teixeira*, *A.E. Williamson*, F. Qian

    Evaluation of a Thermal Pulp Sensibility Test on Crowned Teeth

32. [b,i] **Joseph Ballatore**, Emilio Couso-Queiruga, *G. Avila Ortiz*

    Linear and Volumetric Bone Changes Following Alveolar Ridge Preservation in Posterior Implant Sites: A Randomized Clinical Trial

33. [b,p] **Lyubov D. Slashcheva**, D. Blanchette, *J.J. Warren*, D.R. Drake, K. Phipps, X. Xie

    Spatial Trends in Severe Early Childhood Caries of Native American Children

34. [b,p] **Nailin Shi**, A.E. Welhaven, D.J. Caplan, X. Xie, C.A. Dang, V. Allareddy, J.L. Kolker, *L. Marchini*

    The Survival of Large Non-occlusal Non-incisal Restorations in Older Adults

35. [b,j] **Eman Ismail**, D. Dawson, *R. Rocha Maia*

    Effect of Dentin Chroma on the Color of Double-Layered Resin

36. [v] **Linjing Shu**

    Immediate Implant Combined With Modified Socket-Shield Technique

Pre-Doctoral Posters

11:45 a.m. - 12:45 p.m., Iowa Institute for Oral Health Research, W220 A/B

(c) Procter & Gamble Competition
(d) ADA Pre-Doctoral Table Clinics Competition
(h) Iowa Society for Periodontology Pre-Doctoral Award
(t) James S. Wefel Pediatric Pre-Doctoral Competition

37. [t,c] **Leah Barshinger**, *K. Weber-Gasparoni*, F. Qian

   A Tale of Two Manuscripts: Pre-Doctoral Research Experience in Pediatric Dentistry

38. [c,d,t] **Tanner Brolsma**, *K. Leary*, T. Mabry, K. Flick, F. Qian

   Patient Failure Rates and Characteristics of Patients at the University of Iowa Pediatric Dental Clinics

39. [c,d,t] **Jasmine A. Butler**, F. Qian, A. Lesch, M. O'Malley, *K. Leary*

   Reasons for Failed General Anesthesia and Sedation of Pediatric Dental Procedures

40. **Connor A. Dang**, N. Shi, C. Pendleton, D.J. Caplan, *L. Marchini*

   Reasons for Failure of Large Non-Occlusal Restorations Among Older Adults

41. [c,d] **Krista J. DeCoursin**, *E.C. Teixeira*, X. Xie

   A Retrospective Study of the Survival Rate of Teeth Restored With Prefabricated Posts Versus Cast Post and Core

42. [c,d] *E.C. Teixeira*, **Hannah. G. Deery**, S.R. Armstrong, C. Vidal

   Bond Strength of the Cement Interface to Dental Materials

43. [c,d] **Aminata Dumbuya**, *L. Marchini*, *S.L. Sousa Melo*, A. Farias Gomes, C.L. Comnick, E. Zeng

   Degenerative Diseases of the Temporomandibular Joint Among Older Adults

44. **Layton J. Fritsch**, *T.A. Marshall*

   pH and Titratable Acidities of Ready-to-Drink Coffees and Smoothies

45. **Cameron Gray**, M.T. Remy, *L. Hong*

   Optimization of Gelatin Hydrogel Bioink for 3D Printing

46. **Ryan. M. Hemsley**, M. Zhu, A. Villhauer, *J.A. Banas*

   Low pH Mutans and Non-Mutans Streptococci in Dental Plaque From Children With and Without Caries

47. [c,d] **Benjamin. J. Jacobson**, *N.E. Holton*, T. Yokely

   Morphological Relationship Between the Nasal Septum and Chondrocranial-Derived Components of the Cranial Base

48. [c,d,t] **Erin D. Kallsen**, *F. Qian*, K. Leary, L. Barshinger, *K. Weber-Gasparoni*

   Clinicians' Critical Thinking During Caries-Risk Assessment of Young WIC-Enrolled Children

49. [c,d] **Madison M. Kasparek**, *T.A. Marshall*

Social Media Use by Dental Students for Dietary Information

50. [c,d] **Hannah Klaassen**, *K. Dukes, L. Marchini*

Patient Satisfaction With Dental Treatment at a University Dental Clinic: A Qualitative Analysis

51. [c,d] **Nicole Krois**, *L. Marchini*, A. Kossioni, P. Barlow, M. Bertolini Fernandes Dos Santos, E. Carrera Malhão

Preliminary Validation of a European Instrument to Measure Clinical Learning Environments for Dental Students (DECLEI) in Brazilian Dental Schools

52. [c,d] **Caroline LaRoy**, F. Qian, A. Bedran-Russo, *C. Vidal*, B. Voy

Use of Hydroxy Acids for Etching: Dentin Adhesion and Collagen Degradation

53. **Mary Y. Li**, T. Busch, W.O. Awotoye, M.A. Musa, M. Hassan, *A. Butali*

Association of Catenin Alpha-2 (CTNNA2) With Cleft Palate in Sub-Saharan African Populations

54. [c,d] **Sh Lu**, *M.R. McQuistan*, F. Qian

Comfort and Beliefs Predict Students' Willingness to Treat Underserved Populations

55. **Amy Mayse**, *D.R. Drake*, A. Villhauer

Characterization of *Streptococcus mutans* in a Dental College Population

56. [c] *J.J. Warren*, **Elise Montesinos**

Beverage Consumption Patterns in Early School-Aged American Indian Children

57. [c,d] **Ryan P. Mooneyham**, I. Jasek, K. Dibbern, M. Andrew, A.E. Welhaven, *V. Allareddy, D. Anderson, K. Shin*

Fracture Energy Assessment of the Mandible Computed Using CBCT

58. [c] F.M. Siqueira, **Grace. S. Moore**, E.A. Lanzel, *M.S. Campos*

Effect of Four Cardiac Hormones on Oral Squamous Cell Carcinoma Proliferation

59. [c,d] *M.R. McQuistan, J. Hartshorn*, M. Oishi, **Emma Mueldener**, F. Qian

Post-Graduate Geriatric Dental Curriculum in the United States

60. [c,d] **Donte M. Nesbitt**, *S.C. McKernan*

Factors Associated With Altruistic Attitudes in Dental Students and Residents

61. [c,d] **James V. Park**, *A. Butali*, T. Busch, T. Reid, S. Gupta, W.O. Awotoye, A. Dear

Identifying Variants Contributing to Nonsyndromic Orofacial Clefts in Dachshund Family Transcription Factor 1 Gene in Multiple Populations

62. [c,d,t] **Nathan M. Peterson**, *K. Leary*, M.K. Geneser, K. Weber-Gasparoni, P. Iben, A.I. Owais, *F. Qian*

Caries Increment in Children Following Application of Silver Nitrate or Silver Diamine Fluoride: A Retrospective Study

63. [c,t] **Elizabeth Pfohl**, *M.K. Geneser, F. Qian*, K. Leary, K. Weber-Gasparoni, A.I. Owais, P. Iben

Caries Progression Following Treatment With Silver Diamine Fluoride and Silver Nitrate: A Radiographic Retrospective Study

64. [c,d] **Zachary W. Prouty**, *J.C. Reynolds, R.A. Kuthy*, S.C. McKernan, P.C. Damiano

Community Size and Dentist Acceptance of Public Dental Plans

65. **Turner Reid**, C. Lo, J. Park, *T. Busch*, W. Awotoye, S. Gupta, A. Dear, *A. Butali*

Variation in the Dachshund Family Transcription Factor 1 and Dickkopf WNT Signaling Pathway inhibitor 1 contribution to Nonsyndromic Orofacial Clefts

66. [c,d,t] **Samantha Resnick**, *M.C. Skotowski, F. Qian*

Caries Risk Assessment Factors and Dental Caries Experience in Children

67. [c,d,h] **Jordan I. Roszhart**, V. Allareddy, S. Kumar, *S. Elangovan*

Reporting of Statistical Non-Significance in Randomized Controlled Trials in Dentistry

68. [c] **Ryan. J. Rucker**, P. Barlow, M. Bertolini Fernandes Dos Santos, E. Carrera Malhão, A. Kossioni, *L. Marchini*

Preliminary Validation Study of a Novel Ageism Scale Designed for Dental Students in Brazil

69. [c,d] **Logan W. Sardzinski**, A.E. Welhaven, X. Xie, G.L. Wehby, S. Weinberg, M.L. Marazita, L.M. Moreno Uribe, *B.J. Howe*

Phenotypic Spectrum of Enamel Defects in Nonsyndromic Orofacial Clefting

70. **Rebecca A. Schneider**, A. Villhauer, *D.R. Drake*

Genotype Profiles of Lactobacilli From American Indian Children

71. [c,d] **Ryan P. Shaw**, *M.R. McQuistan*, F. Qian

Do Dental Students' Attitudes Predict Actual Treatment of Underserved Populations?

72. [c,d] **Erika Takanami**, F. Qian, M. Zhu, A. Villhauer, *J.A. Banas*

Acidogenicity and Acid Tolerance of Oral Streptococci Obtained From Dental Plaque

73. [c,d] **Steven C. Thrap**, *J.J. Warren*, D. Starr

Prevalence of Pediatric Dental Treatment Completed Under General Anesthesia Among American Indian Children in Northern Plains Tribal Community

74. [c,d] **Katherine E. VanFosson**, *D.S. Hoffmann*, C.L. Anderson

Dental Student Stress and the First Year Curriculum

75. [c,d] **Trystan Wiedow**, E. Bell, D.E. Ehrlich, T. Soejima, S.F. Miller, M.L. Marazita, S. Weinberg, *L.M. Moreno Uribe*

Maxillary Arch Variation in Relatives of Individuals With Orofacial Clefts

76. [c,d,t] **Adam Woroniecki**, *K. Leary*, A.I. Owais, M.K. Geneser, P. Iben, M.J. Kanellis, K. Weber-Gasparoni, F. Qian

The Relationship Between Behavior of Children and the Success of Medical Management of Caries Using Silver Diamine Fluoride Or Silver Nitrate: A Retrospective Study

Graduate, Faculty & Staff Posters & Table Clinics

11:45 a.m. - 12:45 p.m., Iowa Institute for Oral Health Research, W220 A/B

(e) ADA Post-Doctoral Table Clinics Competition
(g) Endodontic Michel Fuller Post-Doctoral Award
(k) Oral & Maxillofacial Pathology Post-Doctoral Award
(l) Oral & Maxillofacial Radiology Post-Doctoral Award
(n) Orthodontics Post-Doctoral Award
(o) Pediatric Dentistry Post-Doctoral Award
(p) Preventive & Community Dentistry Post-Doctoral Award
(q) Prosthodontics Post-Doctoral Award
(r) Basic Science Post-Doctoral Award
(u) International Basic Research Faculty/Post-Doctoral Award
(v) International Clinical Research Faculty/Post-Doctoral Award

77. [e,r] **Timothy Acri**, *A. Salem, K. Shin*

Simulated Body Fluid Mineralized Matrices Embedded With Non-viral Gene-based Growth Factors for Bone Tissue Engineering

78. **Michelle Biz**, C. Cucco, *B. Cavalcanti*

Effects of Gold-Poly-L-Lysine Nanocomplexes Incorporation in Dental Pulp Stem Cells for Micro-CT Analysis

79. [e] **Juan P. Castro Cuellar**, *S. Anamali*

Spontaneous Healing of a Buccal Bifurcation Cyst: A Case Report

80. [e,o] *V. Allareddy*, *A.I. Owais*, **Bryce Evans**

Quality of Life in Children With Unilateral Cleft Lip/Palate

81. **Amanda Farias Gomes**, Y. Nejaim, F. Haiter-Neto, *S.L. Sousa Melo*

Image Properties of Graphene Oxide in Cone Beam Computed Tomography

82. [e,o] **Casey S. Goetz**, *M.K. Geneser, A.I. Owais*, F. Qian

The Use of Virtual Reality Goggles on Patient Pain and Behavior in Pediatric Dentistry: A Pilot Study

83. [e,o] **Kirstina J. Gratz**, *S.C. McKernan*, C. Pendleton, *K. Leary*

Pediatric Dentists' Satisfaction With Previous Associate Employment Agreements

84. [e,o] **Nathan M. Green**, *M.K. Geneser, A.I. Owais*, E. Zeng, C.L. Comnick

Pediatric Dentists' Opinions regarding Non-traditional Clinical Hours

85. [e,r] **Yuwei Guo**, M.E. Sweat, F. Shao, Y.Y. Sweat, S.L. Eliason, B.A. Amendt, *H. Cao*

Single Cell Transcriptome analysis of Tooth Initiation

86. [e,o] **Elizabeth Hechler**, *K. Leary*, K. Weber-Gasparoni, F. Qian

Head Lice and Pediatric Dentistry

87. [e,p] **Aparna Ingleshwar**, *J.C. Reynolds*, S.C. McKernan, P.C. Damiano

Explaining Member Intention to Complete Dental Healthy Behaviors — An Examination of Iowa's Medicaid Healthy Behaviors Program

88. **Leela R. Jaidev Chakka**, *C. Vidal*, S.R. Armstrong, *A. Salem*

Mesoporous Silica Nanoparticles With Sustained Release of Proanthocyanidins Enhancing Dentin-Resin Interactions for Restorative Dentistry

89. e,g **Brittany G. Kawas**, *B. Cavalcanti*, M.S. Campos, A. Williamson, X. Xie, F.B. Teixeira

Efficacy of Gutta Percha Removal and Time Required for Retreatment With XP-3D Shaper and XP-3D Finisher, ProTaper Retreatment Files, and Gates Glidden Systems

90. e,g **Jay F. Leer**, *A.E. Williamson*, F. Qian, D.R. Drake

Efficacy of an Alternative Brand Device for Warm-Vertical Compaction

91. **Leonardo Marchini**, D.J. Caplan, J.C. Reynolds, S. Sasser, R. Carlene

Predictors for Having a Dentist Among Older Adults in Iowa

92. **Robert N. Staley**, F. Qian

Comparison of Torque Angles in Wide and Narrow Edgewise Brackets

93. e,k **Felipe Nor**, C. Nor, L.W. Bento, Z. Zhang, W.A. Bretz, *J.E. Nor*

Propolis Reduces the Stemness of Head and Neck Squamous Cell Carcinoma

94. e,l **J J. Orgill**, S. Anamali, S. Vijayan, *V. Allareddy*

Visualization and Assessment of the Relationship Between the Inferior Alveolar Canal and the Mandibular Third Molars With Three Different Monitors

95. e,p **Paula Ortega-Verdugo**, *J.J. Warren*, J.L. Kolker, D. Shane

A Case-Control Study to Assess the Cost-Effectiveness of the Stepwise Caries Removal Procedure (SWP)

96. e,r **Fan Shao**, M. Li, M.E. Sweat, Q. Qian, Y. Guo, *B.A. Amendt*, *L. Yang*, *H. Cao*

Comprehensive Identification of Micropeptides Encoding Long Noncoding RNAs in Human Tissues

97. e,r **Ino Song**, D. Seol, *J. Martin*, *K. Shin*

Progenitor Cells Homing via MSC Exosomes for Temporomandibular Cartilage Repair

98. e,r **Dan Su**, F. Shao, S.L. Eliason, *H. Cao*, *B.A. Amendt*

Identification of New Targets of miR-24-3p in Mouse Odontogenic Cells

99. e,p **Jennifer M.C. Sukalski**, *J.C. Reynolds*

Access to Dental Care: The Role of the Oral Health Workforce

100. **Cassia C. Toia**, F.B. Teixeira, C. Cucco, *B. Cavalcanti*

Gaps and Voids in Root-End Filling Materials: A Micro-Ct Analysis

101. **Amy Vermeer**, *B. Cavalcanti*, M.S. Campos, A. Williamson, F. Teixeira

Micro-Computed Tomographic Evaluation of Obturation Quality: Analysis of Methodology

102. [e,n] **Clint Wire**, S.J. Christensen, S. Marshall, T.E. Southard, *F. Qian*, *K. Shin*

    Utilization of Mini-Screw Supported RME Vs. Traditional RME to More Successfully Achieve a Midpalatal Sutural Split in Adolescent Patients

103. [e,r,q] **Kan Wongkamhaeng**, J.A. Banas, J.A. Holloway, A.J. Haes, *I.L. Denry*

    Antimicrobial Activity of Silver Ions and Nanoparticles — A Comparative Study

Evidence-Based Research Session

Presentations by D3 students (Moderator: Teresa Marshall)
9:30 a.m. - 11:45 a.m., Margeas Classroom W205

Abstracts

1. A Proposed Use of miRNAs and miRNA Inhibitors As Potential Therapies for Tumors

Steven L. Eliason[1], Y.Y. Sweat[1], C. Chalkley[1], H. Xu[1], H. Cao[1], K.A. Brogden[1], L. Hong[1], *B.A. Amendt*[1]

[1]University of Iowa, Iowa City, IA

The mis-regulation of miRNAs is a critical part of the tumor etiology in many tumors. The Amendt lab has been using miRNA technology to study and improve our knowledge of cancer progression and eventually provide additional treatment options for oncologists. Two studies have focused on colon cancer. In a previous study, we have demonstrated that cancer outcomes can be improved by the overexpression of micro RNA miR-26b, though the down regulation of the Wnt signaling gene *Lef1*. *Lef1* has been shown to activate proto-oncogenes c-MYC and Cyclin D1. In response to clinical data that shows micro RNA miR-210 is upregulated in the most aggressive forms of colon cancer, our most recent studies have focused on inhibiting miR-210 using a plasmid-based miR-210 inhibitor to reduce the growth of colon cancer cells *in vivo*. Furthermore, we have demonstrated a very novel regulatory role for miR-210 in the expression of the long non coding RNA XIST. Oral cancer, including cancers of the lips, tongue, cheeks, floor of the mouth, hard and soft palate, sinuses, and pharynx (throat), are a significant public health issue and miRNAs like miR-21 has been implicated in the etiology of some of these oral cancers. In the next phase of these studies, we propose to look at the role of miR-21 and other miRNAs in available oral cancers lines using a combination of *in vitro* and *in vivo* approaches.

2. Potential Therapeutic of IL-37 in TMJ Inflammation: A Key Suppressor of Inflammation Required IL-1R8 Mediated by Inhibits the p38 and ERK MAPKs Pathways

Jie Xu[101]

[101]Chongqing Medical University, Chongqing, China

Objective: Temporomandibular joint (TMJ) inflammation usually cause severe joint pain and played a crucial role in the initiation and development of TMJOA. Recently, IL-37 was reported as a natural suppressor of innate inflammation. This study was undertaken to evaluate the anti-inflammatory effects of IL-37 in TMJ inflammation and in SD-rats with disc-perforation-induced inflammation.

Methods: The expression of IL-37 was verified in synovial fluid, synovium, disc and articular cartilage using ELISA and IHC. Human TMJ chondrocytes were treated with IL-37 and IL-1β and inflammation-related factors were detected by real-time PCR and western blot. siRNA-IL-1R8 was transfected into chondrocytes and relative pathways were detected. IL-37 was used in disc-perforation of TMJ inflammation model in SD rats and micro-computed tomography, IHC, real-time PCR and western blot were used to verify the therapeutic effect.

Results: IL-37 is highly expressed in the synovium, disc and articular cartilage of OA patients. IL-37 was highly expressed in synovitis compared with OA patients and TMJ disc displacement in synovial fluid. *In vitro* results, IL-37 suppressed the expression of pro-inflammatory factors of IL-6, IL-8, and dampened the expression of matrix metalloproteinase MMP1, MMP3, MMP9, MMP13 and ADAMTS4 in mRNA levels and MMP1, MMP9, MMP13 in protein levels. In disc-perforation of TMJ inflammation model in SD rats, IL-37 suppressed inflammation and reduced joint destruction. In addition, IL-37 exerted anti-inflammatory effects by inhibiting the signals of p38 and ERK MAPKs pathways, while Silencing of IL-1R8 leaded inflammation upregulated and enhance these signals.

Conclusion: This study revealed that IL-37 emerges as a key suppressor of inflammation in TMJ inflammation, which recruited the IL- 1R8 to transduce anti-inflammatory signals by suppressing p38 and ERK MAPKs pathways in extracellular space. These findings indicate a potential use of IL-37 in the treatment of TMJ inflammation.

3. Knockdown of MicroRNA Let-7a Improves the Functionality of Bone Marrow-Derived Mesenchymal Stem Cells in Immunotherapy

Yu Yang[101], L. Liao[130], B. Shao[101], X. Su[130], S. Yi[130], H. Wang[130], F. Shang[130], Z. Zhou[130], D. Yang[101], Y. Jin[130]

[101]Chongqing Medical University, Chongqing, China; [130]Fourth Military Medical University, Xi'an, Shaanxi, China

Objective: This study aimed to develop a microRNA-based strategy to improve MSC immunotherapy.

Methods: miRNA microarray of MSCs was performed using the LC Sciences microarray platform. let-7a mimics, inhibitor, or negative control was used in *in vivo* and *in vitro* experiments. Expression level of Fas and FasL were detected by Real-time PCR and western blot. MCP-1 levels in the culturing medium supernatants was measured using an ELISA kit. A Transwell system was used to detect T cell migration. FCM was performed to analyze the apoptosis of CD3+ T cell. Inflammatory colitis was induced in

mice (C57BL/6) by feeding with 3% DSS. Mice were monitored daily for the changes of body weight , diarrhea, fecal bleeding, and survival rate. To evaluate the development of GVHD, body weight and survival situation of mice after BMT were monitored daily.

Results: Bioinformatic analysis revealed that let-7a targeted the 3'UTR of mRNA of Fas and FasL, both of which are essential for MSCs to induce T cell apoptosis. Knockdown of let-7a by specific inhibitor doubled Fas and Fas ligand (FasL) protein expressions in MSCs. Because Fas attracts T cell migration and FasL induces T cell apoptosis, knockdown of let-7a significantly promoted MSC-induced T cell migration and apoptosis *in vitro* and *in vivo*. Further more, MSCs with let-7a knocking down were more efficient to reduce the mortality rate of mice suffering from inflammatory colitis by preventing the weight loss, suppressing the inflammation reaction, and alleviating the tissue lesion of experimental colitis and graftversus-host disease (GVHD) mouse models.

Conclusion: Knockdown of let-7a significantly improved the therapeutic effect of MSC in cytotherapy on inflammatory bowel diseases and GVHD. With high safety and convenience, it might be a potential strategy to improve MSC therapy for inflammatory diseases in clinic.

4.   Cell Media Components From Reprogramed Odontoblast Cells Activate Epithelial Specific Genes in Wildtype Cells

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Objective: The objective of this study is to characterize and investigate the capability of genetically reprogrammed MDPC-23 cells to alter gene expression of wild-type cells *in vitro*. Alteration of a cell's developmental fate could have important implications on the ability to induce tissue formation from engineered cell lines.

Methods: MDPC cells, an odontoblast-like cell line, were previously modified to over-express the developmental transcription factor PITX2 and microRNA 200a. This modified cell line and the wild-type cell line were cultured for 48 hours. Cells were collected, centrifuged, and the media from the modified cell line was used to re-suspend and seed new wild-type cells. After 48 hour growth in this media, the cells were harvested for RNA and subjected to qPCR analysis.

Results: MDPC and MDPC PITX2 200a cells had differential expression of a number of important developmental genes, including Zeb1, VIM, E-cad, and TWIST. Interestingly, MDPC cells grown in media harvested from modified cells showed up-regulation of PITX2, Zeb1, E-cad, and TWIST.

Conclusions: MDPC odontoblast mesenchymal cells normally express TWIST and Zeb1, a negative regulator of E-cad, at high levels, but the reprogramming using PITX2 and microRNA 200a leads to increased expression of E-cad, an established marker of ameloblast cells. These dental mesenchyme cells that have been reprogrammed to an epithelial fate demonstrate the ability to induce gene expression changes in wild-type cells *in vitro*. The mechanisms of this process are unknown, but are important for future research in tissue engineering.

5.   Novel microRNA-Incorporated 3D-Printed Scaffolds for the Treatment of Critical-Sized Bone Defects

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MicroRNAs (miRs) are essential regulators of osteogenesis and can be used to enhance bone tissue formation. Critical-sized defects are challenging to treat using current grafting measures; however, 3D printing allows for the design of synthetic grafts, which can be incorporated with osteo-inductive factors, such as miR-200c, to further enhance bone regeneration.

Objective: The aim of our study is to use 3D-printed scaffolds to promote bone regeneration using a hybrid materials approach where β-TCP scaffolds are incorporated with both collagen and miR-200c to enhance osteogenic differentiation and new bone formation in critical-sized defects.

Methods: β-TCP scaffolds were fabricated using suspension-enclosing projection-stereolithography (SEPS). The scaffolds were coated with collagen (3 mg/mL) and miR-200c (10 µg/mL) and then freeze-dried. For the *in vitro* study, scaffolds were seeded with hBMSCs and cultured for up to 14 days. We evaluated scaffold surface topography and collagen/hBMSC distributions using SEM imaging and DAPI staining. OCN and Runx-2 expression was quantified using qRT-PCR. For the *in vivo* study, miR-Coll-TCP scaffolds were implanted into critical-sized calvarial defects in rats for 4-weeks and bone formation was measured using µCT and histology.

Results: Collagen and hBMSCs were evenly dispersed throughout the scaffolds. The expression of miR-200c in miR-Coll-TCP is significantly higher than single-treated scaffolds. OCN and Runx-2 expression is more up-regulated for miR-Coll-TCP than other samples. µCT images showed miR-Coll-TCP implants with more bone formation than other treatments. Bone formation was statistically significantly higher in miR-Coll-TCP than other implants. H&E staining further

confirmed increased bone formation in miR-Coll-TCP scaffolds.

Conclusions: β-TCP scaffolds coated with miR-200c incorporated collagen increased the transfection efficiency of miR-200c and osteogenic differentiation of hBMSCs *in vitro* and bone formation *in vivo*, attesting to the therapeutic potential of miRs for bone regeneration. This 3D printing, hybrid approach may lead to superior scaffolds for the treatment of critical-sized defects.

6. Ablation of Sox2 in the Developing Oral Epithelium Results in Cleft Palate and Ankyloglossia
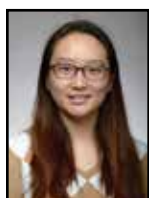
<u>**Yan Y. Sweat**</u>[1], W. Yu[1], Z. Sun[1], M.E. Sweat[1], S.L. Eliason[1], *B.A. Amendt*[1]

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With a frequency of 1:500-2,500, cleft lip with or without cleft palate (CL/P) is the most common congenital craniofacial defect. In mice and humans, a complex gene regulatory network (GRN) controls the different processes required for palatogenesis. Ankyloglossia is identified in over 3 million newborns each year in the US alone. Both of cleft palate and ankyloglossia are usually treatable with surgeries, and speech and social training, which can cost more than 200,000 dollars. Understanding the genetic underpinnings of cleft palate and ankyloglossia will aid in understanding the etiology of the disease and could lead to better genetic screens or treatments. In this work, we discovered inactivating the Sry (Sex determining region Y)-box 2 (Sox2) gene in the developing oral epithelium resulted in cleft palate and ankyloglossia with 100% penetrance in embryos examined after E14.5. Further examination revealed that an epithelial adhesion that highly expressed the oral epithelial markers E-Cad and P63 was responsible for fusing the anterior tip of the tongue with the mandible. To determine the cause of this inappropriate adhesion, we assayed the expression of keratin 6 and found decrease in the formation of the periderm, a transient layer that forms in the developing oral cavity and functions to prevent oral adhesions. More work is required to determine if Sox2 promotes the differentiation of basal cells into periderm, or if Sox2 is only required for periderm maintenance.

7. Developing miR-enriched Exosomes As a miR-based Gene Therapy for Obesity-Associated Periodontitis
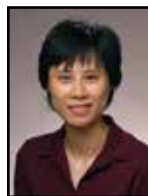
<u>**Min Zhu**</u>[1], S.L. Eliason[1], *B.A. Amendt*[1], *L. Hong*[1]

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Periodontitis and obesity are deeply associated chronic inflammatory diseases. Our previous studies showed that miR-200c has strong capabilities for modulating inflammation. However, an efficient delivering miR-200c for clinical application is needed.

Exosomes are small membrane vesicles of endosomal origin, which are secreted from a variety of cell types. Exosomes can be transported between different cells and influence physiological pathways in the recipient cells, which indicating its potential role for miR-200c delivery .

Objective: The objective of this project is to test whether miR-200c enriched exosome could potently repress inflammation.

Methods: Exosome was extracted from culture supernatant of HEPM cell with miR-200c overexpression. The exosome was transfected into adipose cell and human gingival cell (HGF). Cells were harvested after 48h and RNA was extracted from cells. Expression of miR-200c and IL-6 was determined by qPCR.

Results: Expression of miR-200c increased 5-fold in exosome-transfected adipose and HGF cells comparing to control cells. Expression of IL-6 decreased 10-fold in exosome-transfected cells comparing to control cells. The results indicated that miR-200c enriched exosome delivered miR-200c into adipose cell and human gingival cell, and miR-200c inhibited inflammatory cytokine IL-6 in cells.

Conclusion: Exosome enriched with special miR could be a promising delivery tool for miR-based gene therapy of obesity -associated periodontitis, although further *in vivo* studies are needed.

8. Targeted Sequencing of *Mrpl53* Identify Rare Missense Variants That Are Associated With Orofacial Clefts in Multiple Populations

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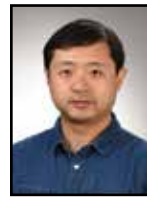
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Orofacial cleft (OFC) is a congenital defect resulting from the abnormal development of the orofacial structures. A new candidate gene, Mitochondrial Ribosomal Protein L53 (*MRPL53*) has been recently shown to be associated with nonsyndromic cleft lip with or without cleft palate (NSCL/P), a sub-type of OFC in Brazilian cohort. *MRPL53* gene encodes a 39S protein subunit of mitochondrial ribosomes and interacts with a transcription factor, *MYC* involved in the development of the craniofacial region. To identify rare mutations in this gene that may explain the genetic basis of OFC in other populations, we performed a targeted sequencing of this gene in 1247 multiple populations (Africans, Puerto Ricans, Iowans and Filipinos) OFC samples. When possible, the parent samples were sequenced for the identification of *de novo* mutations. We identified 2 known rare missense variants in the Puerto Rican samples and 1 known rare missense variant in the African samples. The 2 missense variants: rs202083153 (c.216C>A; p.Arg73Cys) and rs574615587 (c.274T>C; p.Ser92Pro) segregates in the family and are predicted to be deleterious and damaging on SIFT and PolyPhen. The missense variant rs751976686 (c.133A>T; p.Thr45Ser) segregates in the family and is predicted to be tolerated and benign. These variants rs202083153, rs574615587 and rs751976686 have Combined Annotation-Dependent Depletion (CADD) scores of 32, 22.4 and 22.4 respectively, indicating that these variants are among the top 0.1% (CADD score of 32) and 1% (CADD scores of 22.4) deleterious variants in the human genome. HOPE analysis of the amino acids changes revealed possible loss of interactions due to changes in size for the 3 variants, while rs202083153 (c.216C>A; p.Arg73Cys) and rs574615587 (c.274T>C; p.Ser92Pro) resulted in more hydrophobic proteins due to loss of the hydrogen bonds. This study identified variants in *MRPL53* gene that contribute to the genetic risk of OFCs in Puerto Rican and African populations.

9. microRNA-126 Enhances the Angiogenesis and Inhibits Inflammation in Dental Pulp

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The responses of dental pulp repair to inflammation and angiogenesis are closely related. Promoting neovascularization and inhibiting inflammation is supposed to prevent the development of pulpitis from reversible to irreversible. It has been demonstrated that miR-126 could promote angiogenesis and inhibit vascular inflammation in endothelial cells by repressing three target genes Sprouty-related EVH1 domain-containing protein 1 (SPRED1), phosphoinositol-3 kinase regulatory subunit 2 (PIK3R2), and vascular cell adhesion molecule 1 (VCAM1). However, the roles of miR-126 have not been explored in dental pulp inflammation.

Objective: The purpose of this study is to detect the expression and role of miR-126 in dental pulp or dental pulp cells (DPCs) which are challenged with LPS *in vitro*.

Methods: Normal dental pulp and irreversible pulpitis tissue were collected from an oral surgery and endodontic clinic. DPCs were cultured from part of normal dental pulp tissue and the plasmid of miR-126 (pSil-4.1miR126) was construed. DPCs or DPCs transfected with pSil-4.1miR126 were challenged with 100ng/ml LPS for 6 and 24h. Real-time PCR detected the expression of miR-126, SPRED1, PIK3R2, VCAM1and VEGF in normal dental pulp, irreversible pulpitis tissue, and DPCs..

Results: In irreversible dental pulp, the expression of VEGF was significantly increased and the miR-126 was decreased dramatically. After transfection with pSil-4.1miR126 for 24h, the expression of miR-126 was upregulated. In the meantime, LPS decreased the expression of miR-126 and increased the expression of SPRED1, PIK3R2, VCAM1 and VEGF in DPCs.

Conclusions: These results suggest miR-126 may promote the angiogenesis and inhibit inflammation in dental pulp via SPRED1, PIK3R2, VCAM1.

10. 255 nm Light Emitting Diode (LED) in Combination With Bleach (NaClO) Is More Effective in Killing *E. faecalis* in Root Canal Therapies

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Treatment of infected or inflamed endodontic tissues requires chemo-mechanical debridement of canal spaces, unfortunately, infections can reoccur.

Objective: In this study, we assessed the ability of bleach (NaClO) in combination with 255 nm light emitting diode (LED) to kill *Enterococcus faecalis*, a common bacteria associated with persistent reoccurring infections after treatment.

Methods: To show this, *E. faecalis* was put into holes in a blood agar plate and treated with water (control), 255 nm LED and water, 1% NaClO, 255 nm LED then 1% NaClO, or 1% NaClO then 255 nm LED. The holes were rinsed and treatments were spotted onto blood agar. At 24 hours, colonies were counted and statistical differences were determined.

Results: *E. faecalis* remained viable in control treatments (38.1+1.6 SEM CFU, n=18). In comparison, *E. faecalis* treated with 255 nm LED had significantly less CFU (9.8+0.7 SEM CFU, n=18, $p < 0.05$) and *E. faecalis* treated with 1% NaClO had significantly less CFU (10.1+1.2 SEM CFU, n=18, $p < 0.05$). *E. faecalis* treated with 255 nm LED followed by 1% NaClO also had significantly less CFU (2.1+0.4 SEM CFU, n=18, $p < 0.05$) and *E. faecalis* treated with 1% NaClO followed by 255 nm LED had significantly less CFU (1.2+0.3 SEM CFU, n=18, $p < 0.05$).

Conclusion: The results in this study suggest a new treatment modality using 255 nm LED and NaClO in combination as an adjunct to chemo-mechanical debridement for the sterilization of infected and inflamed sites.

11. Low-Intensity Pulsed Ultrasound Suppress the Inflammation of Periodontal Ligament Cells From Periodontitis Patients and Enhance the Osteogenic Differentiation through Endoplasmic Reticulum Stress Pathway

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Objective: To investigate the effect of low-intensity pulsed ultrasounds (LIPUS) on the inflammation and the osteogenic differentiation ability of periodontal ligament cells from periodontitis patients and the underlying mechanisms.

Methods: A real-time polymerase chain reaction (PCR) and an enzyme-linked immunosorbent assay (ELISA) were used to test the expression of inflammatory factors. The expression levels of bip, p65, ire1a, and IkBa were assessed by western blots (WB). Transmission electron microscopy is used for the ER observation. Micro-CT, hematoxylin-eosin (HE), Masson's trichrome were used in the animal model to check the absorption of the Alveolar bone. Activation of the UPR target genes in PDLCs in periodontitis-associated chronic inflammation. Transmission electron microscopy (TEM) images of the endoplasmic reticulum (ER) in H-PDLSCs and P-PDLSCs.

Results: The expression levels of UPR-related genes, proteins and the secretion of inflammation factors were significantly higher in periodontal ligament stem cells (p-PDLSCs) from periodontitis patients compared with healthy periodontal ligament stem cells (h-PDLSCs). However, the expression of osteogenic differentiation-related genes are lower in the p-PDLSCs. Moreover, the use of the low-intensity pulsed ultrasounds (LIPUS) increase the osteogenic differentiation both *in vitro* and *in vivo*.

Conclusion: In summary, the periodontal ligament stem cells (PDLSCs) from periodontitis patients shows a higher ER stress level and a decreased osteogenic differentiation ability compared to healthy periodontal ligament stem cells (PDLSCs). And the use of the low-intensity pulsed ultrasounds (LIPUS) decrease the inflammation and protect the osteogenic differentiation function, owning to the ERss pathway.

12. Identifying Dental Pain Behaviors in Older Adults With Dementia: A Preliminary Study Using the Delphi Technique

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Oral health is poor in older adults with dementia. This increases the risk of dental pain and infection in these individuals, but no tool is currently available to specifically and reliably assess dental pain in nonverbal dementia patients.

Objective: Using the Delphi technique, this study aims to identify behaviors related to dental pain in dementia patients with limited communication capacity.

Method: Fifty-one pain-related behaviors were identified based on literature review and clinical experience and then grouped into five categories. Eight geriatric dental experts were recruited to assess the usefulness of the selected behaviors in identifying dental pain in four scenarios (i.e., at rest, during eating, during drinking, and during oral care) using a 3-level Likert scale. Summative score were ranked to reflect the usefulness of these behaviors in identifying dental pain.

Results: When at rest, the patient refusing dental prostheses, rubbing or massaging jaw/face, avoiding cold food/drink, flinching, pained expression, and pulling lips or cheeks were considered the behaviors most indicative of dental pain. Change in appetite, avoiding cold food/drink, pained expression, rubbing or massaging jaw/face, flinching, grimacing, protesting and using pain related words and pushing or pulling away were considered the best dental pain indicators during eating. During drinking, avoiding cold food/drink, flinching, rubbing jaw/face, grimacing, protesting and using pain-related words, and pushing/pulling away were the best indicators for dental pain. When oral care is conducted, flinching, rubbing/massaging jaw or face, grimacing, pained expression, pushing or pulling away, thrashing and resisting, refusing or being uncooperative to mouth care were most useful dental pain indicators.

Conclusion: A set of behavior indicators were identified to detect dental pain in persons with dementia, providing a foundation for future study.

13. Application of Gene-Activating BMP-2/FGF-2 Collagen Scaffolds for Dental Pulp Capping

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Objective: To evaluate the effect of non-viral gene therapy on human dental pulp stem cells (hDPSC) in an *in vitro* and an *ex vivo* model.

Methods: Plasmid DNA encoding for FGF-2 and BMP-2 was transformed and isolated from *E. coli* cells to form nanoplexes by complexing polyethyleneimine (PEI) with pDNA. The nanoplexes were studied for their particle size, stability and transfection efficiency on hDPSC. Nanoplexes were also applied on hDPSC to evaluate cytotoxicity, protein expression and mineralization activity. Collagen scaffolds loaded with the nanoplexes and MTA were utilized in an *ex-vivo* tooth culture model to assess pulp response to direct pulp capping for up to 14 days, after which teeth were fixed and processed for H&E staining.

Results: *In vitro* data were statistically analyzed by ANOVA and Tukey's test. Average nanoplex particle size was 152±0.2 nm with a transfection efficiency of 13%. hDPSC treated with the nanoplexes showed increased cell proliferation and enhanced expression of BMP-2 and FGF-2 proteins. Collagen scaffolds containing nanoplexes significantly increased cell proliferation, BMP-2 and FGF-2 expression, and mineralization when compared to MTA.

Ex vivo histology showed a well preserved pulp and healthy tissue in both the MTA and scaffold groups. Connective tissue in contact with the scaffold was dense and homogeneous, with some cells present in contact and within the scaffold.

Conclusions: The transfected nanoplexes showed increased expression of BMP-2 and FGF-2 proteins, superior cell compatibility and mineralization properties compared to MTA. These findings were supported by the *ex vivo* observations.

14. Dentin Regeneration by a Novel microRNA

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Cutting-edge developments in the field of regenerative endodontics allow for tooth repair and regeneration utilizing tissue engineering approaches.

MicroRNAs (miRs) are small non-coding RNA molecules that regulates many biological processes including inflammation and tissue regeneration. Previous research has identified that miRs, specifically the miR-200 family, play an essential role in tooth development.

Objective: The goal of this study is to characterize the expression of miR-200c between immature and mature human dental pulp tissue and to determine molecular function of miR-200c during odontogenic differentiation.

Methods: Dental pulp tissue (n=8) was collected from healthy human third molars. The expression of miR-200c between immature and mature pulp tissue was quantified by real-time PCR. Furthermore, primary human dental pulp cells were collected and seeded in 6 well-plates. Subsequently, the dental pulp cells were transfected with 200c overexpression using PEI nanoparticles. The expression of 200c was quantified after 3 days post-transfection and the odontogenic markers were quantified after 7 days post-transfection by real-time PCR.

Results: We observed that miR-200c had a higher expression in the immature teeth compared to the mature teeth. Additionally, the overexpression of miR-200c increased odontogenic markers (Runx2, OCN, DMP1 and DSPP) in human dental pulp cells.

Conclusions: These data suggest that miR-200c may play an important role in vital pulp therapy and endodontic regeneration.

15. Evaluation of Photo-Crosslinked PAMAM/GelMA Hydrogel for Bone Regeneration

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Objective: The aim of our study is to construct a photo-crosslinked hydrogel by combining and modifying natural polymer gelatin with synthetic polymer polyamidoamine (PAMAM). This hydrogel is expected to possess tunable mechanical, degradation, and biological properties and be able to build bone tissue engineering scaffold to promote bone regeneration.

Methods: Gelatin and PAMAM were separately modified by using methacrylic anhydride (MA) and tested by 1H NMR. The modified gelatin and PAMAM were mixed at 4 different concentrations and exposed to UV light to synthesize hydrogels. Hydrogels were characterized by scanning electron microscope (SEM), compressive strength test, swelling ratio tests and degradation tests. Mouse pre-osteoblasts (MC3T3-E1) were encapsulated in hydrogels for 3D cell culture and the cell viability, proliferation and osteogenic differentiation ability of MC3T3-E1 cells were examined.

Results: The results of 1H NMR confirmed that gelatin and PAMAM were successfully modified by methacrylic anhydride. SEM results showed that the pore sizes of hydrogels decreased with the increase of PAMAM concentration. The results of the swelling ratio and degradation test showed that the swelling ratios and degradation rates of hydrogels decreased significantly with increasing of PAMAM concentration. The mechanical properties of hydrogels are also enhanced with the addition of PAMAM. 3D cell encapsulation and culture results showed that all groups of hydrogels displayed excellent cell viability (>90%). Proliferation of cells was not affected by the addition of PAMAM. With the addition of PAMAM, hydrogels have a tendency to promote osteogenic differentiation of MC3T3-E1 cells.

Conclusion: The PAMAM/GelMA hydrogels synthesized in this study have tunable mechanical, degradation and biological properties. This is achieved by adjusting the ratio of gelatin and PAMAM. Hydrogels with different composition ratios all have good biocompatibility and bioactivity. In summary, this photo-crosslinked PAMAM/GelMA hydrogel has the potential to serve as bone tissue engineering scaffolds to promote bone regeneration.

16. Insulin-Like Growth Factor 1 Receptor Plays a Role in Enamel and Root Development

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Objective: Insulin-like Growth Factor 1 receptor (IGF1r) is a transmembrane receptor with tyrosine kinase activity that plays a signaling role in cell survival and proliferation. IGF1r stimulates elongation of the dental root in tooth development. However, the specific role of IGF1r in this process remains unknown. The aim of this study was to evaluate the dental phenotype of conditional abolished IGF1r in enamel organ cells.

Methods: IGF1rflox/flox mouse were bred with Pitx2cre to obtain mice Pitx2cre-IGF1rflox/flox in order to evaluate the dental phenotype of mice with conditional IGF1r under the expression of Paired Like Homeodomain 2 (Pitx2). Mice were sacrificed at either 21 or 42 days post-natal and their weight was recorded. Skeletal staining was performed to evaluate differences in bone formation in the control and test group. Pictures of the teeth were obtained. Root morphology was evaluated by μCT. Enamel organization was evaluated by SEM. Histological analysis of the periodontium was subsequently performed.

Results: It was observed that 21 days post-natal Pitx2cre-IGF1rflox/flox mice were smaller with statistically different weight (mean = 6.2±1.3 g for test; 9.85±0.21 g for control). At day 42 the weight difference was consistent with the previous observation (mean = 13.23±3.39 g for test; 19.58±2.76 g for control). No difference in bone formation was found between groups. Conditional IGF1r knockout mice present a very identifiable dental phenotype. Test mice had smaller teeth with less tooth structure and exhibited altered enamel prisms organization. The dental root of Pitx2cre-IGF1rflox/flox mice showed an abnormal morphology with no furcation. Cementum, PDL and bone had normal structure and fiber orientation.

Conclusion: In conclusion, conditional abolished IGF1r appears to alter enamel formation and the shape of the dental roots. Further research is needed to elucidate the pathways that are regulated by IGF1r during tooth development.

17. Mapping the Lower Incisor Stem Cell Niche With Single Cell Resolution

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The murine lower incisor is an excellent model to study the differentiation and self-renewal of pluripotent stem cells. The cells that reside within the labial cervical loop (LaCL) compose the stem cell niche of the lower incisor and this niche is maintained throughout the life of the animal. There are several different types of cells inside of the niche, including the pluripotent dental epithelial stem cells (DESCs) that give rise to the other lineages that compose the lower incisor. Studies aimed at investigating the DESC population have uncovered some information about them, for example, that they express *Sox2* and Bmi1. However, these two DESC markers are also expressed by other cells within the cervical loop, and better markers for DESCs remain to be found. Other cell types, which arise from the DESC population, have been identified within the stem cell niche (ex. Stellate Reticulum and outer enamel epithelium), but their role within the LaCL remains poorly understood. This work aims to characterize the gene expression profiles of different cell types within the stem cell niche, including elucidating markers specific for DESCs and other cell types. To uncover the expression profiles of individual cells in the LaCL, we performed scRNA-seq by dissecting and dissociating the LaCLs from P3 *Sox2-EGFP* knock in pups. Gene expression was interrogated using the 10x scRNA-seq system. Cells from the LaCL clustered into five major groups, which strongly expressed epithelial markers and other markers of the LaCL, including *Pitx2*. Group 0 expressed markers of DESCs and group 2 expressed markers of the slightly more differentiated transient amplifying population. By examining the expression profiles of the different cell clusters, the identity of the cells could be determined. More work is required to determine what genes are critical for the formation of these different cell types within the stem cell niche of the lower incisor, and what function they may have in supporting niche maintenance and differentiation.

18. MMPs Extraction Assay and Enzymatic Profile in Carious Lesion Progression

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Objective: This study aimed to develop an optimized *in vitro* protocol for MMPs extraction from dentin and investigate their proteolytic profiles in the progression of carious lesions.

Methods: Dentin powder obtained from human healthy (H), initial caries (contained within enamel) (I) and deep carious (cavitated) (C) molars underwent a protein extraction using a protocol that included incubations with: 2.5mM NaCl followed by 4M guanidine HCl + 65mM Tris-HCl pH 7.4, 1% phosphoric acid demineralization for 10 min and overnight incubation with buffer containing 50 mM Tris-HCl, 5 mM $CaCl_2$, 100 mM NaCl, 0.1% Triton X-100, 0.1% nonionic detergent P-40, 0.1 mM $ZnCl_2$ and 0.02% NaN_3 pH 6.0, and a second incubation with 4M guanidine HCl+ 65mM Tris-HCl pH 7.4. Experiments were run in triplicate. The amount of total protein extracted was evaluated. The MMP gelatinolytic activity was analyzed using zymography and densitometry was performed using ImageJ. The presence of MMP-1, -2, -3, -7, -8, -9, -10, -12, and -13 was determined using a multiplex kit. Qualitative analysis was performed to compare results among healthy, incipient and caries dentin samples.

Results: The total protein content and overall gelatinolytic activity of carious dentin was the highest, followed by incipient and then healthy dentin. A change in the gelatinolytic profile was observed in C when compared to H and I conditions, with less MMP-2 and an increase of low molecular weight gelatinases in C. The multiplex assay results also demonstrated a shift in MMPs profile among the conditions.

Conclusions: The newly developed assay is effective in extracting MMPs from dentin. Increased protein concentration and a shift in enzymatic activity and protein diversity in the progression of healthy to carious dentin supports the role of specific MMPs in caries dentin degradation.

19. Development of a Cognitive Screening Assessment for Dental Practitioners

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Objective: Cognitive impairments (CI) affect 5.5 million older adults aged 65 and above and present a unique challenge to dental clinicians in recognizing CIs and providing appropriate care. Current cognitive assessment tools are not tailored for a dental setting and are typically not used by dentists. To that end we aimed to develop a cognitive screening tool to be used in dental environments.

Methods: 82 participants aged 65 or older, English speaking, without physical impairment, and patients at the University of Iowa College of Dentistry and Clinics between June 2018 to August 2018 were recruited for this study. The proposed cognitive screening tool with 11 candidate items, the Montreal Cognitive Assessment (MoCA), and the Mini-Cognition Test (Mini-Cog) were administered by a trained and calibrated dental student to assess the cognitive status of the study participants. Different combinations of the candidate items were tested against the MoCA and Mini-Cog to assess their performance as a cognitive screening tool using the Mann Whitney ranked one-way ANOVA and the Fisher's exact test. The ROC analysis and Youden's statistic were used to determine the cut-off value that can be used as a diagnostic tool in determining cognitive status.

Results: The mean age of the participants was 73.7 (SD = 6.6). 45.1% were female. When the MoCA was used as the gold standard, there was a statistically significant difference in both candidate item 1 and 11 responses between impaired and non-impaired participants ($p = 0.0017$, $p < 0.0001$, respectively). Furthermore when the Mini-Cog assessment was used to determine cognitive impairment, this difference persisted (Item 1 p-value = 0.0027, Item 11 p-value = 0.0013).

Conclusions: Candidate items 1 or 11 have great potential to serve as a screening tool to assess cognitive impairment in dental settings.

20. Programmed Dual Delivery Hierarchical Scaffold Coatings Eradicate Biofilms and Accelerate Bone Tissue Repair Partly through Osteoimmunomodulation

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Objective: To positively regulate cellular response to the biomaterial surface, we demonstrate that a dual delivery system coated on a 3D-printed titanium scaffold which is generated by selective laser melting (SLM) can sequentially deliver Ag+ and Sr2+ in a time-staggered manner to eradicate established biofilms and induce a beneficial balance of osteogenesis over osteoclastogenesis through manipulating immune response, achieving the final improvement of osseointegration and prevention of infection.

Methods: This complicated dual delivery system with strontium (Sr) releasing can directly enhance bone regeneration and osseointegration. Furthermore, alkali-heat substrate is required to maintain their osteogenic properties and surface characteristics since defined macro-, micro- or nanostructure promotes e.g. protein absorption and adhesion of cells to a certain extent contributing to the crucial steps of osseointegration. Finally, Dopamine can self- polymerizes into polydopamine (PDA) at weak alkaline conditions to form coatings on the previous substrate. The resultant PDA coating enables in situ reduction and stable immobilization of silver nanoparticles on surface owing to the high reductive properties of catechol moieties in PDA layer.

Results: The coating's physical (morphology and wettability) and chemical (composites and crystallinity) properties have been analyzed by SEM, EDS, XPS etc. It exhibits numerous favorable physicochemical properties, such as hybrid macro-micro-nano morphology, hydrophilicity, and highly crystalline silver nanoparticles. The ICP analysis indicates that the nanolayered construct allows precise independent control of release kinetics and loading of Ag+ and Sr2+ in an infected implant environment. The controlled release of Ag+ can generate adequate antibacterial activity without showing cytotoxicity. Continuous delivery of Sr2+ up to 21 days shows the long lasting osteoinductive ability of this scaffold. Significantly improved antimicrobial and osteoconductive property have been proved *in vitro*. Our results show that AH-Sr-AgNPs surface modification can yield a microenvironment adverse for bacteria survival but suitable for M2 macrophage polarization. Sr-containing nanostructures can markedly up-regulate M2 macrophage phenotype expression (Arg,CD206). *In vivo*, infected femoral shaft defect was established to evaluate the bone repairing effects of the 3D-printed implant on infected bone defects

scenarios, micro-CT, microbiological and histological and histomorphological analyses were used to confirm that this programmed dual-delivery system can enhance anti-infectious and bone repairing properties.

Conclusion: Our results indicate that this 3D-printed scaffold with programmed delivery system has the ability to favorably influence early immunoinflammatory macrophage cell functions and the functionality of osteogenesis cells, resulting in an enhanced osseointegration and anti-infection outcome.

21. Enhancing Student Learning of Removable Prosthodontics Using the Latest Advancements in 3D Modelling

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When educating dental students or Prosthodontic residents a picture can be worth a thousand words. With that said, then what is enhanced 3D modeling worth? The answer is undoubtedly more than what a picture can provide, and that is why the use of 3D models has become increasingly common with respect to patient care with time. However, while they have started to make an appearance in dental education, many of the current 3D modeling techniques do not offer the flexibility needed for dental education. At the University of Iowa, the use of 3D modeling software has enabled the creation of 3D models that can be altered or customized to be used in a more flexible way to teach students in the arts and complexities of Partial removable dental prosthesis (RDP) design and components. This oral presentation will: 1) demonstrate how these 3D models can be used enhance the student perception and learning of RDPs; and 2) will also discuss and demonstrate using video capture on how the models used for our educational purposes were created.

22. Identifying Nursing Home Residents at the End of Life in Dental Settings

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Objective: Life expectancy should be a consideration during dental treatment planning of institutionalized older adults. The goal of this analysis was to develop an easy-to-use tool for dental personnel to identify institutionalized older adults in their last year of life.

Methods: This analysis was based on an existing database with 903 nursing home residents seen in the Walker Dental Clinic in St. Paul, MN, between 10/1999 — 12/2006. Individuals who died within one year of an initial comprehensive dental examination were identified using the National Death Index (NDI) in 2011. Sociodemographic information, medical history, cognitive and functional status and oral exam data collected during that examination were used to predict death within one year post-dental appointment. 10-fold cross-validation using 75% of the available data was used as a training set in developing predictive multivariable logistic regression models. Models were evaluated based on Predictive Accuracy and AUC (Area-Under-Curve) using stepwise variable selection for model generation.

Results: Among the 903 participants, 656 (72.6%) were female. The mean age at baseline was 80.3 (SD=11.7), and 190 (21.0%) died within one year after the exam. Individuals of male gender, older age, incapability of oral care, incapability of getting into dental chairs independently, congestive heart failure, peripheral vascular disease, cancer, cerebrovascular disease, chronic renal disease and moderate to severe liver disease were more likely to die within a year of the exam. The model containing these variables had a predictive accuracy of 0.80 (SD = 0.03) and an AUC of 0.76.

Conclusion: In this sample, 10 variables collectively were predictive of death within one year, with an accuracy of 80%. Pending additional validation of this model in other similar populations, these variables could be used to identify nursing home dental patients in the last year of life and thus help inform decision-making during dental treatment planning.

23. Iowa Dentist Tracking System: 20 Year Highlights

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Objective: This presentation will review trends in Iowa's dentist workforce using data from the first 20 years (1997-2016) of Iowa Dentist Tracking System (IDTS). IDTS is a unique and comprehensive data source that has been used for workforce recruitment, planning, analysis, and research.

Methods: A dental advisory committee, consisting of representatives from Iowa Dental Association, Iowa Dental Board (IDB), and UI College of Dentistry guides the monitoring process. IDTS collaborates with IDB and maintains a subscription to an Iowa electronic newspaper service to identify dentists entering or leaving the state workforce. Staff semiannually contact dentists' offices to update individual and practice indicators (e.g., hours worked per week, practice arrangement). Descriptive analysis is a

compilation of 20 years of information based on year-end data.

Results: The proportion of general dentists in private practice who are under 60 and work full-time has dropped from 60.4% to 44.2% of the workforce. The percent of dentists who were 60 years or older rose from 13.3% to peak at 27.1% (2015) and female dentists increased from 11% to 28%. Percentage of Iowa dentists who are University of Iowa graduates almost showed almost no variation (74-75%) during this time period. Solo practice declined from 59% to 40%. Although there has been a doubling of female dentists practicing in rural counties, it did not offset the decline in male dentists practicing there. Percentage of dentists who work, on average, 40 or more hours per week has declined from 57.4% to 34.1%. A higher percentage of female dentists worked part-time (i.e., < 32 hours per week) (range: female 18.1% to 24.7%; male 9.8% to 15.7%).

Conclusions: The current workforce looks much different than in 1997. In 2016, more dentists are older, female, work in group practices, work in urban areas, and work fewer hours per week on average.

24. Oral Health Needs and Perceptions of Seriously-ill Persons Receiving Palliative Care

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Physiological, psychological, and functional changes at the end of life have a dramatic effect on oral health. Unfortunately, there is no information regarding how seriously-ill older adults with limited life expectancy perceive the needs and value of oral health or their preferences for oral health care, making it challenging to appropriately care for these vulnerable individuals.

Objective: This study aims to explore self-perceived oral health needs and values among seriously-ill persons receiving palliative care.

Methods: Twenty-two participants who were age 18 or above, English-speaking, having an advanced, incurable health condition and receiving palliative care were recruited from the University of Iowa Palliative Care Clinic. Consented participants were interviewed regarding perceived oral health needs and values and their preferences for oral health care using a structured questionnaire. Descriptive statistics were conducted to describe perceived needs and values of oral health and oral health care.

Results: Participants averaged 61 years old. 55% were female and 45% had cancer. 27% reported that oral health declined in the past year and that mouth conditions affected their quality of life. The most commonly reported oral health condition is dry mouth (64%), followed by oral dysfunction (23%), pain (23%), cavity (17%) and fungal infection (14%). Given their current health conditions, 73% reported they are likely/very likely to see a dentist in the near future. Participants valued oral health care with teeth cleaning, treatment for gum disease, filling cavities that are sensitive or might cause pain and pulling non-restorable and painful teeth as the most favorable treatments and emergency treatment only to control toothache or infection as the least favorable treatment.

Conclusion: A considerable proportion of seriously-ill participants suffered oral conditions that significantly affected their quality of life. Given their current health condition, oral health care is still favorable in seriously-ill persons receiving palliative care.

25. A Population-Based Study of Orofacial Cleft Risk and Gene/Smoking Interactions

Aline L. Petrin[1], W. Lyu[1], P.A. Romitti[1], M.M. Jenkins[109], R.G. Munger[111], J.C. Murray[1], A.J. Wilcox[112], R.T. Lie[108], G.L. Wehby[1], *L.M. Moreno Uribe*[1], N. National Birth Defects Prevention Study[109]

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Nonsyndromic orofacial clefts (OFCs) are among the most prevalent birth defects, affecting on average 1 in 700 births. Maternal smoking is the most well-established environmental factor that may contribute to OFC risk; however, gene-environment interaction studies continue to show conflicting results, possibly due to heterogeneity in risk by maternal and fetal smoking detoxification gene variants. We examined the interaction effects between first trimester maternal smoking (active and passive) and variants in 7 smoking detoxification genes (maternal and fetal *CYP2E1, ELAVL2, GRID2, GSTP1, NAT2, TBK1, ZNF236*) on risk of nonsyndromic OFCs. We combined individual-level data from 5 population-based studies—Iowa Case Control Study, National Birth Defects Prevention Study, Norway Facial Clefts Study, Norwegian Mother and Child Cohort, and Utah Child and Family Health Study—to create the largest population-based case-control sample to date for this assessment, consisting of 1,330 (1,743) case children (mothers) and 2,549 (3,417) control children (mothers). We evaluated interactions using multivariable logistic regression, including fixed effects for study site, maternal age and education

at delivery, pre-pregnancy body mass index, and first-trimester alcohol consumption and folic acid/multivitamin use. We observed interactions between maternal active smoking and variants in maternal *ZNF236* and *TBK1* for risk of cleft lip. We observed interactions between maternal passive smoking and variants in maternal *CYP2E1* for risk of any cleft, and variants in fetal *NAT2* for risks of cleft lip with palate and cleft lip only. These findings suggest heterogeneity in the risk of nonsyndromic OFCs subtypes associated with interactions between maternal active or passive smoking and maternal or fetal variants in certain smoking detoxification genes. A better understanding of the effects of maternal risk behaviors during pregnancy on the etiology of OFCs is a key step to developing effective counseling and prevention programs for women at risk, especially for modifiable behaviors.

26. Factors Associated With Toothpaste Use Among Low-Income Families

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Objective: To assess factors related to access to toothpaste and toothpaste use patterns in children from low-income families.

Methods: The study was conducted at the University of Iowa Pediatric Dentistry Clinic and the Women, Infants and Children (WIC) Nutrition program sites in Iowa City and Des Moines. Parents of children 0-5 years of age were recruited and asked to complete a questionnaire. Items included frequency of toothbrushing, whether toothpaste was used, if they had trouble obtaining toothbrushes or toothpaste due to cost, and knowledge of fluoride. Data were entered into Excel and descriptive statistics were generated in SPSS. Chi-square tests were used to assess relationships between regular brushing and independent variables.

Results: 349 questionnaires were completed (129 at the Pediatric Dentistry Clinic, 134 at Iowa City WIC and 86 at Des Moines WIC). Children's ages ranged from 0-16 years, but most were 5 years old or younger. 74% reported that they regularly used toothpaste for their child, and 68% of the children brushed their teeth once per day or more. 20% reported trouble obtaining toothbrushes or toothpaste because of cost. Bivariate analyses found that parents who made more than $20,000 per year, brushed their child's teeth with toothpaste, and did not think fluoride was harmful were more likely to have their kids brush once per day or more.

Conclusion: Limited use of toothpaste, and lack of regular toothbrushing appears to be significant problems in this lower income population. Infrequent

brushing was related to income and lack of knowledge about toothpaste.

27. Early Childhood Caries Among Premature Children Enrolled in WIC: A Twenty-Year Retrospective Study

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Objective: The primary aim of this study was to determine if there was an association between gestational age and Early Childhood Caries experience in the primary dentition, while secondarily evaluating factors that may influence development of caries in premature children, compared to full-term children.

Methods: Data were collected from records of children aged 0-4 years attending the University of Iowa's Infant Oral Health Program (IOHP) located at the Johnson County Women, Infants, and Children (WIC) program. Each mother completed questionnaires regarding her prenatal history and her child's demographics, neonatal history, oral hygiene and dietary habits. Evaluations of visible plaque, enamel defects, and caries were obtained via clinical examination. Bivariate evaluations of association were performed using chi-square tests, Fisher's exact tests or Wilcoxon-Mann-Whitney tests, as appropriate. Odds ratios (ORs) were calculated as measures of association. Multivariate modeling of caries status was carried out using logistic regression. The level of significance was set at 0.05.

Results: To be determined.

Conclusions: To be determined.

28. The Effect of Stabilization Splint Therapy to Bone Remolding of Condylar Resorption in Juvenile Patients

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Objective: To study the effect of stabilization splint therapy to bone remolding of different types of condylar resorption in juvenile by CBCT imaging.

Methods: 83 juvenile condylar resorption patients were studied. 59 patients were selected to receive the treatment of stabilization splint, 24 patients

were selected as control group without stabilization splint treatment. CBCT was taken before and after treatment. The condylar resorption patients were divided into three types: type I, type II and type III according to the pre-treatment CBCT. According the before and after CBCT comparison, the condylar resorption went into 4 prognoses: progression, no changes, stabilization and remodeling. Progression and no change were considered to be ineffective, stabilization and remodeling were considered to be effective. The proportion of progression was calculated in two groups. The condylar height was measured before and after treatment.

Results: The effectiveness of splint group was significantly better than control group in type I and type II (P<0.05), but no difference between two groups in type III (P>0.05). Condylar resorption progression percentage of the splint group (43%) was significantly smaller than control group (80%) in type II (P<0.05), while no difference between two groups in types I and III (P>0.05). Before and after treatment, the condylar height was significantly reduced in two groups of type II (P<0.05). The height of condylar in three types showed reduced trend, and no difference between two groups (P>0.05).

Conclusions: The stabilization splint was effective to promote the bone remolding of condylar resorption in juvenile patients, especially in type I and II (early resorption stage). But the reduction of the condylar height is irreversible, regardless of splint treatment or not.

29. Dental Anomaly Image Classification Using a Convolutional Neural Network

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Objective: Children with orofacial clefting (OFC) present with a wide range of complex dental anomalies. Identifying these dental anomalies is vital to understanding the complex phenotypic spectrum of orofacial clefting. Such anomalies are currently identified using intra-oral exams and/or photos and this process is time consuming, particularly for large samples. Therefore, automating the process of anomaly detection using neural networks (NN) could increase reliability and speed of anomaly detection. This study characterizes the use of NN to identify dental anomalies using intraoral photographs in one of the largest international cohorts to date of children with nonsyndromic OFC and controls.

Methods: Intraoral images from 1,937 subjects were previously scored for dental anomalies by human raters whom achieved inter-rater reliability

of kappa=0.91-0.93. A convolutional neural network (CNN) performed multi-class classification of 8 dental anomalies (mammelons, impacted, hypoplasia, rotated, incisal fissures, fluorosis, hypocalcification, and displaced) using a photo for each subject simultaneously displaying the maxillary and mandibular canine-to-canine region. The network predicts whether or not a patient exhibits any of the aforementioned anomalies. Training and testing of the CNN on the total sample were performed in an 80/20% split respectively. The network architecture consisted of two convolutional layers and two linear layers.

Results: The CNN, for all subjects, identified the dental anomalies with an average accuracy of 68.2%. Per anomaly, accuracy ranged from 50-100%, FPR from 0-8% and FNR from 0-46%, except for rotation and hypocalcification.

Conclusion: We show that a naïve neural network image classifier can attain an accuracy consistent with an interrater-reliability kappa of substantial agreement, suggesting that the CNN has the potential to be an alternative rating method of dental anomalies in intraoral photographs, thus decreasing time spent and facilitating dental anomaly rating standardization for future large multicenter studies.

30. Effect of Time and Temperature on Color Stability of Dental-Composite

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Objective: To evaluate the effects of different temperatures and times of coffee exposures on the color stability of three types of dental composites (DC).

Methods: Three types of DC were used to fabricate standardized discs (n=288; 96/DC): microfilled, microhybrid, and nanofilled (shade A2). Discs measurements were 2mm in thickness and 3mm in diameter. After being light cured with a LED unit at the energy level recommended for each DC, discs were polished using sand paper under water irrigation. All samples were initially stored in an incubator in distilled water for 24-hours at 37C° and each DC group was further divided into 6 subgroups (n=16): 65C° coffee, 37C° coffee, 4C° coffee, 65C° distilled water, 37C° distilled water, 4C° distilled water (control group). Baseline color was measured by spectrophotometer with color changes (ΔE*) recorded after 24-hours, 3.5-days, and 7-days.

Interactions between composite, temperature, and time were not observed; the main effects were examined using one-way ANOVA followed by the post-hoc Tukey's HSD test or a Bonferroni adjustment (alpha=0.05).

Results: Mean ΔE* observed with coffee exposures for microfilled DC (11.58±6.37) was higher than for nanofilled DC (10.64±6.77; p<0.001), and mean ΔE* for nanofilled DC was higher than for microhybrid DC (9.26±5.83; p<0.001). For all DC, mean ΔE* observed with coffee exposure at 65°C (18.33±4.32) was higher than at 37°C (7.03±2.05; p<0.001), and mean ΔE* at 37°C was higher than at 4°C (6.11±2.67; p<0.001). Mean ΔE* after coffee exposure for 24-hours (8.64±5.35) was lower than for 3.5-days (11.07±6.50; p<0.001) and 7-days (11.76±6.84; p<0.001); no difference was observed between 3.5-days and 7-days (p=0.0769).

Conclusion: The findings of this study indicated that temperature, composite type, and expose time affect the color stability of DC, with higher temperature affecting the color stability more than lower temperatures.

Supported by: University of Iowa College of Dentistry, Department of Operative Dentistry

31. Evaluation of a Thermal Pulp Sensibility Test on Crowned Teeth

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Objective: The goal of this *in vivo* study was to assess the accuracy of cold testing (Endo Ice: 1,1,1,2-tetrafluoroethane) in determining pulp vitality on teeth with full-coverage restorations and the effect of several variables on the reliability of the test.

Methods: Data were collected from 825 patients needing endodontic treatment in the Endodontic Clinic at The University of Iowa College of Dentistry and Dental Clinics. The experimental group included 425 crowned teeth, while the control group was comprised of 400 teeth without crowns. The results of the pulp sensibility test, tooth type, tooth number, type of crown, age, gender, presence or absence of caries, and recent use of analgesics were recorded. The ideal standard of direct pulp inspection was used to verify the diagnosis.

Results: For crowned teeth, the sensibility test results showed accuracy, 0.866; sensitivity, 0.835; specificity, 0.879; PPV, 0.746; and NPV, 0.926. The data indicated a significant difference in the accuracy of pulp sensibility test results between the experimental group and the control group. Teeth without crowns were more likely to have true positive and true negative results than teeth that were crowned (91.5% vs. 86.6%, p=0.0244). No significant differences were found with regard to gender, tooth type, type of crown, presence of abutment, and recent use of analgesic (p>0.10).

Conclusion: Pulp sensibility testing with cold on teeth with full-coverage restorations is less accurate than on teeth without full-coverage. However, using cold to determine pulp vitality still has high accuracy (86.6%).

Supported by: AAE Foundation for Endodontics

32. Linear and Volumetric Bone Changes Following Alveolar Ridge Preservation in Posterior Implant Sites: A Randomized Clinical Trial

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Objective: The primary objective of this randomized clinical trial (RCT) was to evaluate linear and volumetric bone dimensional changes following tooth extraction and alveolar ridge preservation via socket grafting (ARP-SG) in posterior sites using two different biomaterials. A secondary goal was to evaluate radiographic marginal bone loss (MBL) around implants placed in those sites up to one-year follow-up post-functional loading.

Methods: Patients with posterior teeth indicated for extraction who met the study eligibility criteria were recruited and randomized into one of two ARP-SG therapies: Control (Particulate cortical allograft [FDBA] covered with a collagen sponge) and Test (Alloplastic material [GUIDOR® Easy-Graft® Classic]). A CBCT was taken at baseline and 4 months post-extraction. At 5 months post-extraction, implants (Straumann®) were placed and then restored at a minimum of 4 months following implant placement. Clinical measurements and standardized radiographs of the implant sites were taken within one week of final prosthesis delivery, at 6 months and 12 months post-delivery.

Results: 23 patients participated in the study (12 Test and 11 Control). Mean volumetric bone reduction was less in the control vs. test group (13.9% vs. 21.6%), but was not statistically significant (p = 0.3124). There was significantly greater loss in volume in sites performed in the maxilla vs. mandible (26.4% vs. 9.8%, p = 0.0376). Control sites lost a mean of 0.38mm buccal bone height while test sites lost a mean 1.00mm (p = 0.1623), but it was not statistically significant. No significant difference was observed for interproximal MBL surrounding implants between groups at either baseline, 6 months or 12 months post-delivery of the final prosthesis.

Conclusion : Both ARP-SG therapies were associated with favorable ridge preservation and implant-related outcomes up to one-year post-loading. However, the control therapy exhibited slightly more favorable results in terms of bone volume maintenance and mid-facial alveolar ridge height.

Supported by: Sunstar Americas

33. Spatial Trends in Severe Early Childhood Caries of Native American Children

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Objective: This study investigated the effect of geographic location on dental caries in Native American children under age three from a Northern Plains Tribal community.

Methods: Geographic location of study participants was ascertained by postal district and categorized into geographic regions as well as dental clinic accessibility defined as dental services available in that district. The association of location category and dental caries (dmfs and ds) was evaluated cross-sectionally at ages 16 and 36 months of age.

Results: Descriptive statistics demonstrated differences in dental caries distribution by location category. Bivariate analysis of disease by location showed significant spatial differences in dmfs and ds at 36 months (p=0.0027 and p=0.0028) but not 16 months. Bivariate analysis of disease by dental clinic accessibility showed significant spatial difference in ds at 36 months (p=0.0091). Multivariate regression modeling suggests the unique location effect on dental caries experience among other covariates such as dietary, demographic, maternal, and household factors.

Conclusions: Distribution of severe early childhood caries in this sample of young Native American children is nonrandom and varies by location. At 36 months of age in this cohort of Native American children, geographic location is a significant dental caries risk factor. Research and programs designed for children with high risk of severe early childhood caries and should consider a locational variation.

34. The Survival of Large Non-occlusal Non-incisal Restorations in Older Adults

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Root caries is a common problem among older adults, leading to large cervical restorations, pulpal involvement, and extraction. This study aimed to investigate the survival of non-occlusal non-incisal restorations as a surrogate for large cervical restorations among older adults, as well as factors associated with the survival. In a retrospective cohort analysis using The University of Iowa, College of Dentistry electronic health records, we included 2,968 restorations among unique patients aged 65+ who received 2+ surface non-occlusal non-incisal restorations placed from 1/2005-12/2011. Restorations were followed until 9/22/2017 or until they were deemed to have failed, whichever was earlier. Restoration failure was defined as teeth receiving any replacement restoration, endodontic treatment, or extraction. At baseline, subjects' mean age was 75.1 + 7.2 years, and 51.7% were females. Most restorations were composites (68.0%), in upper teeth (65.3%), in anterior teeth (80.0%), placed by dental students (75.4%), and on 2 surfaces (78.8%). The mean annual number of total visits and recall visits was 4.5 + 2.5 years and 1.7 + 0.9 years, respectively. About one-third (37.7%) of the restorations failed during follow-up, with the median survival time being 6.6 years. The hazard of restoration failure increased with increasing number of surfaces (p=0.004), age (p=0.046), and the mean annual number of visits (p<0.001). The hazard of failure decreased with the mean annual number of recall visits (p<0.001). The hazard ratio for amalgam compared to composite was 2.0 (p<0.001). The hazard ratio for males compared to females was 1.2 (p=0.023). The hazard ratio for dental students as providers compared to faculty was 1.2 (p=0.018). In conclusion, material, age, gender, number of surfaces, clinic type, provider type, average visits, and average recall visits were all significant factors associated with the survival of these restorations.

35. Effect of Dentin Chroma on the Color of Double-Layered Resin

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Objective: To compare overall color (ΔE00) and chroma (C*) of double-layered (DL) resin-composite (RC) sample to underlying dentin C* using two RC brands and three dentin shades of (A1, A2, A3) interchanged with three enamel-layer thickness (ET) of (0.5, 0.7, 1.0) mm in comparison with A2 shade-tab.

Methods: Enamel-samples of two RC systems Clearfil-Majesty (CM) (Kuraray) shade A2 and Vita-l-essence (VL) (Ultradent) shade (PN) were fabricated using three custom-made molds to replicate a VITA shade-tab with variant ET (n=7 per ET/RC brand). Dentin-samples were fabricated using customized molds for each ET. Easyshade-V (VITA Zahnfabrik) was used to measure L*a*b parameters and the color difference (ΔE00) was calculated between DL samples and A2 shade-tab. Each E sample was paired with three different dentin samples, thus, a total of 63 readings were recorded per RC system. Spearman rank correlations were used to assess the relationships among ET, ΔE00, C*, dentin shade and change in chroma (ΔC). One-way ANOVA with Tukey post-

hoc adjustment was used to compare ΔE00 among groups. SAS software (Version 9.4) was used with a significance level of 0.05.

Results: Positive correlations (p<0.0001) were observed between ΔC and DL shade depth (r=0.62 for CM, r=0.83 for VL); between ΔC and C* of the dentin base with no enamel (r=0.80, for CM and r=0.92 for VL). Strong evidence for differences in ΔE00 when compared to A2 was identified for both CM (p<0.0001) and VL (p<0.0086)

Conclusions: Variation in dentin shades and ET produced shades that differed from A2 shade-tab depending on the RC system. The closest combination to A2 shade-tab for CM was: A2 dentin with 0.5 mm enamel, whereas, for VL: A1 dentin with 0.5 enamel or A3 dentin with 0.7mm enamel. Enamel layer thickness should be reserved to less than 1 mm as it alters the overall shade significantly.

36. Immediate Implant Combined With Modified Socket-Shield Technique

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Objective: The socket shield technique is a promising surgery to maintain alveolar volume by leaving a buccal root fragment during immediate implantation. To further improve this method and reduce adverse effects, we attempted to keep the gaps between teeth fragments and implants, and fill them with bone graft materials to minimize root resorption. The purpose of this study is to evaluate the stability and feasibility of the modified socket shield technique from clinical evaluations.

Methods: We conducted the modified socket-shield technique in 12 cases. Those buccal portion of roots were retained, implants were placed 2mm away from the shields, bone materials were put into the gaps. The change of Pink Esthetic Score (PES), marginal bone loss (MBL), buccal bone plate thickness (BPT) perpendicularly to the implant surface were examined at different time points.

Results: Twelve patients (7 males, 5 females) were included in this study. Buccal bone kept stable after restoration. The mesial and distal papillae were kept, gingival contour and level were in harmony with the adjective teeth. No implant failed and only one root fragment exhibited complication of exposure.

Conclusion: The modified socket shield technique appears to be a viable treatment procedure to maintain buccal volume in the short-term.

37. A Tale of Two Manuscripts: Pre-Doctoral Research Experience in Pediatric Dentistry

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Objective: Discuss a dental student's experience in pediatric dentistry research projects throughout dental school.

Methods: The first project, "Oral Health Instruction and Practices among Iowa Family Physicians/Pediatricians," investigated the impact that reported instruction during medical training had on the oral health knowledge, perceived comfort level and practices among Iowa family physicians and pediatricians for children 0-to-3 years of age. This study found that reported oral health instruction during medical training was positively related to physicians' knowledge, comfort, and practices regarding important ECC-preventive oral health care. The manuscript for this project was prepared for submission to the *Journal of Dental Education*, a peer-reviewed journal that publishes educational and scientific research in dental, allied dental, and advanced dental education.

The second project, "Factors Associated with Carious Lesions among Young WIC-Enrolled Children," investigated factors associated with non-cavitated and/or cavitated lesions among young children from low-income families who are known to be at higher risk for developing early childhood caries (ECC). This study found that ECC-associated risk factors among WIC-enrolled children include race, low maternal dental-health literacy, dietary habits, poor oral hygiene, while inadequate fluoride exposure, visible plaque, and parental language barrier are significant predictors of future ECC-experience. The manuscript for this project was prepared for submission to *Pediatric Dentistry*, a peer-reviewed journal that promotes the practice, education, and research specifically related to pediatric dentistry.

Results: Results of these projects were presented at local and national meetings. Additionally, a database consolidating 20 years of patient records was created during data collection for the second study. This data will be accessible for future research questions regarding the oral health of low-income high-caries risk children attending the UI IOHP located at a local WIC Clinic.

Conclusion: Results from these projects advance research in the field of pediatric dentistry with an emphasis on the oral health of young children.

38. Patient Failure Rates and Characteristics of Patients at the University of Iowa Pediatric Dental Clinics

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Objective: To compare the characteristics of patients who failed/late cancelled appointments with those who kept appointments in the predoctoral clinics at University of Iowa Pediatric Dental Clinics (UIPDC).

Methods: Data were collected from 1545 patients who failed/late cancelled and 3323 who kept appointments from May 1, 2017 to April 30, 2018. Patient data included: sex, age, distance from UIPDC, time of day-morning or afternoon, day of week, month of appointment, insurance status (private, Medicaid/Hawk-I, or self-pay), and reasons for cancellation/failure. The chi-squared test, Fisher's exact test, Cochran-Mantel-Haenszel test and Wilcoxon rank-sum test were used for the statistical analysis (alpha=0.05).

Results: Regarding the characteristics of those who failed appointments, 51.8% were male, mean age was 9.30, mean distance to the college was 38.5 miles, 14.3% were Hispanic and 69.8% had Medicaid, 93.5% preferred English language, 66.0% missed afternoon appointments and 29.8% missed Monday appointments and 31.9% missed appointments April-June. Among the 3,323 subjects who kept the appointments, 49.7% were male, mean age was 9.26, mean distance to the college was 27.8 miles, 16.5% were Hispanic, 65.42% had Medicaid, 91.8% preferred English language, 63.9% had afternoon appointments and 33.3% of the appointments were April-June. Bivariate analysis revealed subjects with unknown ethnicity were more likely to fail appointments than Hispanic and other ethnic groups (73.7% vs. 28.8% vs. 26.2%; p<0.0001). Compared to their counterparts, subjects who were self-pay (56% vs. 19.7% and 33.2%; p<0.0001), preferred English (32.1% vs. 27%; p=0.0404), had Monday and Wednesday appointments (37.2% and 36.7% vs. 30% and 26.8% and 27.1%; p<0.0001) were more likely to fail appointments.

Conclusions: Initial data demonstrates when patients are more likely to miss appointments based on day of the week and their preferred language. This information will be pivotal to develop targeted intervention methods to increase the percentage of appointments held in the UIPDC.

39. Reasons for Failed General Anesthesia and Sedation of Pediatric Dental Procedures

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Objective: This study evaluated the reasons why pediatric dental patients missed their history and physical (H&P) or treatment appointments utilizing general anesthesia (GA)/procedural sedation (PS), and compared them to patients who kept their appointments.

Methods: Data were collected from a retrospective chart review of 176 patients who failed, late cancelled, or kept their GA, PS, or H&P appointments at the University of Iowa's Pediatric Dental Clinic (UIPDC) between January 1, 2018-May 31, 2018. The information obtained included patients' demographics and reasons why the patient failed their appointments. Statistical analyses consisted of descriptive and bivariate analyses using chi-square test, Fisher's exact test, Cochran-Mantel-Haenszel test, and Wilcoxon rank-sum test (alpha=0.10)

Results: 176 subjects were included, 41 who failed appointments (mean age=8.54±7.13 years; 43.9% males) and 135 who kept appointments (mean age=8.98±8.71 years; 60% males). Of those who failed, 92.7% had Medicaid/DWP and 51.2% had SHCN, compared to those who kept appointments, 77% had Medicaid/DWP and 58.5% had SHCN. The most common reasons for failing appointments were reported as child illness, followed by "other," "unknown," and provider cancelled due to illness. Bivariate analysis revealed females versus males (29.9% vs. 18.2%; p=0.0688) and those that had Medicaid/DWP rather than private insurance (26.8% vs. 8.8%; p=0.0252) were more likely to fail appointments. Age, distance from where a patient lives to the UIPDC and other clinical factors were not significantly associated with failing appointments (p>0.10 in each instance).

Conclusion: Important distinctions were found between patients who failed or late cancelled their appointments and who kept their appointments. Patients who had Medicaid/DWP were more likely to fail their appointments. The findings from this study can help the clinics to address this failure issue.

40. Reasons for Failure of Large Non-Occlusal Restorations Among Older Adults

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Older adults experience a higher rate of root surface caries compared to any other age group. Our aim was to describe the reasons for failure of large, non-occlusal restorations among older adults. In this secondary data analysis, we reviewed University of Iowa College of Dentistry records for patients who had a non-occlusal, 2+ surface restoration placed between January 2005 and December 2011; were at least 65 years old at the time of restoration placement; and experienced a failure of that restoration prior to September 2017, with the reason for failure being recorded in the chart notes. Restoration failure was defined as the tooth subsequently receiving a restoration that included any of the originally involved surfaces (Group 1, n=819); endodontic treatment or extraction (Group 2, n=252). At baseline, patients' average age was 74.9 years (±6.8), and 49.1% were females. Most restorations were composite (57.9%), followed by glass ionomer (30.2%) and amalgam (11.9%). Anterior teeth received 73.9% of the restorations, and most restorations had 2 surfaces (78.3%), followed by 3 (21.3%) and more than 3 (0.4%). For G1, recurrent caries was the most common reason for failure (72%), followed by restoration fracture (9%). For G2, recurrent caries also was the most common reason for failure (47%), followed by tooth fracture (24%). For G1, composite and more recall visits per year were associated with failure due to caries (p=0.005 and p= 0.0041, respectively). Anterior teeth and composite were associated with failure due to tooth fracture (p = 0.0329 and p <0.0001, respectively). For G2, female gender was associated with failure due to periodontal disease (p=0.0002). Recurrent caries was the leading cause for restoration failure with an association with composite in G1.

41. A Retrospective Study of the Survival Rate of Teeth Restored With Prefabricated Posts Versus Cast Post and Core

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Objective: The specific aim of this study is to assess a long-term difference in success and failure rate between ETT with cast post and core and prefabricated posts.

Methods: Retrospective data were compiled on 258 cases (134 CPC, 124 Pre-fab) for a time to event analysis, where the event was extraction. Existing patients' electronic records were reviewed based on the American Dental Association (ADA) Code on Dental Procedure and Nomenclature (CDT) for all permanent teeth that had received a pre-fabricated (D2954) or a cast-post (D2952) between July 1st, 2008 through July 1st, 2010 at The University of Iowa and Dental Clinics. Groups were compared using the log-rank test. When an event occurred, an exact date was available to calculate time. When a subject did not have an event (extraction), July 1st of the last available follow-up year was used as the censoring time. Additionally, four nominal covariates were identified for consideration. Survival curves were generated for each of the covariates and groups were compared using the log-rank test. A joint estimate of the effect of materials and the nominal covariates was estimated using a Cox proportional hazards model. The corresponding hazard ratios, confidence intervals, and p-values are reported. All analyses were performed at the 5% level of significance using SAS 9.4 (SAS Institute, Cary, NC).

Results: Risk of extraction for no adjacent teeth is significantly greater than teeth present on one side (P=0.0167). Also, risk of extraction for no adjacent teeth is significantly greater than teeth present on both sides (P=0.0016).

Conclusions: After 10 years, no significant difference in survival rate of EET was shown between prefabricated posts and cast post and core. When treatment planning, the absence of adjacent teeth to EET teeth that require a post should be considered, due to their long-term survivability.

42. Bond Strength of the Cement Interface to Dental Materials

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Objective: The objective of our study was to assess the effect of the composition of CAD/CAM restorative materials on the bond strength of the adhesive cement/restorative interface when bonded using a conventional and a newly formulated adhesive system.

Methods: The five CAD/CAM materials used were a composite resin nanoceramic, polymer infiltrated ceramic network, lithium disilicate glass-ceramic, 3 mol.% yttria partially stabilized tetragonal zirconia, and 5 mol.% yttria cubic zirconia. The adhesive cement systems were: a one bottle universal adhesive system followed by a dual-cured adhesive resin cement; and a two-bottle universal adhesive

system, followed by a different dual-cured adhesive resin cement. The specimens were flattened with a diamond bur and sintered. The bonding systems were applied, specimens were then placed on a bonding clamp; the resin cement material was inserted and light-cured. Specimens were stored for 24 hours before the shear bond strength test was performed. Descriptive statistics and two-way ANOVA were performed for the analysis of main effects after confirming the normal distribution of data ($\alpha = 0.05$). A statistically significant interaction was observed between the CAD/CAM materials and cements (p= 0.035). Therefore, a one-way ANOVA statistical analysis and Tukey post-hoc test were performed.

Results: The highest bond strength was observed for the composite resin nanoceramic (LU), with bonding performance similar to the polymer infiltrated ceramic network (VE), regardless of the adhesives and cements used. A statistically significant difference in bond strength between the two adhesives resin cements was observed only for the lithium disilicate glass-ceramic (Emax), with lower bond strengths with simplified bonding protocols.

Conclusions: The composition of CAD/CAM materials influences their adhesion to resin cements regardless of the adhesive materials used for bonding. For lithium disilicate glass-ceramic CAD/CAM material the bonding performance can be compromised depending on the adhesive and resin cements used in the bonding protocol.

43. Degenerative Diseases of the Temporo-mandibular Joint Among Older Adults

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Temporomandibular joint (TMJ) may be affected by degenerative diseases such as osteoarthrosis, which are common among older adults. Earlier reports have indicated that oral functions and quality of life are negatively affected in older adults with TMJ problems. No studies have yet applied cone beam computed tomography (CBCT) for assessing TMJ degenerative diseases among older adults. In this study we performed a retrospective evaluation of TMJ morphology on CBCT images of individuals aged 65+. The present study aim to describe the prevalence of degenerative changes of the mandibular condyle, as well as explore possible relationships between degenerative changes in the

TMJ and systemic health related factors. Data were collected from the University of Iowa College of Dentistry electronic health records (EHR). Initially, we obtained a list of patients matching the following criteria: 1) aged 65+, and 2) having a CBCT acquired at the College of Dentistry that contemplates the TMJ area. From this initial list, a random final sample size of 137 CBCT images was reviewed by two expert radiologists, and health history was also retrieved from EHR for the patients composing the final sample. Of these patients, ninety (65.7%) had DJD on at least one side, while 43 (31.4%) had DJD on both sides. Among patients with DJD, the mean number of DJD findings was 2; subchondral cyst was the most common finding (63.3%), followed by osteophytes (60.0%), flattening of the condyle (37.8%), and sclerosis (24.4%). There was no statistically significant association between DJD and the reported systemic health conditions, except for connective tissue disorders (p = .0075). Females had more DJD than males (p=0.0363). In this sample of 137 older adults, DJD was relatively common, subchondral cyst and osteophytes were the most frequent DJD findings, and women had more DJD than men.

44. pH and Titratable Acidities of Ready-to-Drink Coffees and Smoothies

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Ready-to-drink coffees and smoothies are increasing in popularity and becoming a staple in the American diet. The potential of these beverages to erode teeth is unknown.

Objective: Our objective is to measure the pH and titratable acidity (TA) of various ready-to-drink coffees and smoothies to characterize their erosive potential.

Methods: Medium and dark roast coffees, lattes, cappuccinos, and espresso shots were purchased from local coffee shops (e.g. Java House, Dunkin Donuts®, Starbucks®, and Caribou Coffee®). Regular, light/diary free, and protein-infused smoothies were purchased from local smoothie shops (e.g. Orange Julius®, Jamba Juice®, and Power Café). All beverages were purchased in triplicate, and their respected pH and TA were measured using an automatic titrator.

Results: The pH (mean) of medium roast coffees ranged from 4.8-5.6, dark roast coffees from 5.2-5.7, lattes from 6.5-6.6, cappuccinos from 6.4-6.6, and espresso shots from 5.3-6.0. The TA (mean) of medium roast coffees ranged from 0.23-0.60, dark roast coffees from 0.20-0.31, lattes from 0.22-0.34, cappuccinos from 0.24-0.46, and espresso shots from 0.29-1.52. The pH of regular smoothies ranged from 4.1-4.4, light/dairy free smoothies from 3.8-4.3, and

protein-infused smoothies from 4.7-5.0. The TA of regular smoothies ranged from 2.29-2.37, light/dairy free smoothies from 1.39-2.48, and protein-infused smoothies from 1.31-1.45.

Conclusions: The pH of a few ready-to-drink coffees and most smoothies was below pH 5.0, suggesting that these beverages are potentially erosive. The low TAs of all coffees and smoothies suggest that the beverages' buffering capacities are limited, enabling saliva to neutralize the acid and reduce erosive potential.

45. Optimization of Gelatin Hydrogel Bio-ink for 3D Printing

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The ability to 3D print gelatin hydrogels provides greater therapeutic uses in tissue regeneration, therefore the objective of this study was to optimize the concentrations of gelatin hydrogel and crosslinker glutaraldehyde (GTA) to make a bioink that is able to retain shape and function in extrusion-based 3D printing. Gelatin concentration trials yielded that 4-8% gelatin concentration could be viable depending on the printing time. GTA concentration trials yielded optimal setting times at a range of 0.1% - 0.2% concentration. With a Regemat 3D printer, a two layer grid was able to be fabricated with a 6% gelatin and 0.2% GTA hydrogel concentrations using 0.51mm syringe tip with a 3.0 mm/s flow speed and a 3.5 minute latency time (the time after mixing GTA with the hydrogel but before printing). Printing trials did not always yield consistent products, with gelatin hydrogel temperature and latency time creating the most variation between trials.

46. Low pH Mutans and Non-Mutans Streptococci in Dental Plaque From Children With and Without Caries

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Objective: The role of mutans streptococci (MS) within the ecological plaque hypothesis is still a matter of debate. Since MS sometimes comprise only a small fraction of the oral microflora, even in carious lesions, their role as a prominent cariogen is questioned. This study aimed to quantify the presence of non-mutans streptococci that possess MS-like acidogenicity, as well as the MS, in the dental plaque of pediatric patients with or without a history of dental decay.

Methods: Dental plaque samples were obtained from children, placed in phosphate buffered saline at pH 7.0 and plated on media selective for streptococci. A selection of 30 clonal isolates was subcultured for each sample. Each isolate was then grown in 5 mL Brain-Heart Infusion (BHI) and Chemically Defined Medium (CDM) for 24 hours. After 24 hours, the terminal pH of each isolate was recorded to determine acidogenicity of the samples. *Streptococcus mutans* was used as a control for low pH and *Streptococcus sanguinis* in BHI was a control for high pH. The researchers were blinded to the caries status of the patients until after all terminal pH determinations were made.

Results: There was a statistically significant difference of low pH strains in caries-free versus caries patients (p=0.04), however, the difference was due to the increased presence of MS in patients with caries. There was no statistical difference in the recovery of non-MS low pH streptococci between caries free and caries patients. Caries-free patients were more likely than caries patients to harbor high pH strains, but the difference was not statistically significant.

Conclusion: The results of this study showed an increased prevalence of low pH streptococci in pediatric patients with caries versus pediatric patients without caries. However, this difference was due mostly to MS; the contribution of non-MS low pH strains was minor. Further research could be conducted to evaluate a potential correlation between the growth of high pH strains in caries versus caries-free subjects.

47. Morphological Relationship Between the Nasal Septum and Chondrocranial-Derived Components of the Cranial Base

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Objective: During embryonic development, the chondrocranium significantly contributes to the formation of the nasal complex with variation in chondrocranial-derived components of the nasal complex exhibiting an influence on adult nasal morphology. Given the importance of the chondrocranium in nasal form, it is possible that chondrocranial-derived nasal structures are correlated with the midline cranial base. This

relationship, however, has not been investigated. Understanding the variation dynamic between these sites allows us to create a more detailed understanding of the morphological relationship among different chondrocranial-derived craniofacial regions. The purpose of this study was to test the null hypothesis that there is no significant covariation between nasal septal morphology (i.e. size and deviation) and the morphology of the chondrocranial-derived cranial base.

Methods: We tested our null hypothesis using size and shape data derived from k=12 three-dimensional coordinate landmarks using a sample of n=70 CT scans of adult human subjects. Using geometric morphometric techniques, these landmarks were used to determine the strength of covariation between the nasal septum and the symmetric and asymmetric components of cranial base shape variation. Individual landmark configurations were superimposed using Procrustes analysis and covariation was assessed using multivariate regression.

Results: Our results reveal a significant correlation between the size of the nasal septum and the chondrocranial-derived cranial base, (P<0.001). Nevertheless, septal size was uncorrelated with the symmetric (P=0.198) and asymmetric (P=0.988) variation in the chondrocranial-derived cranial base. Similarly, there was no correlation between septal deviation and the symmetric (P=0.547) and asymmetric (P=0.839) variation in the chondrocranial-derived cranial base.

Conclusions: These results suggest that chondrocranial-derived nasal components (at least as represented by the nasal septum) are independent from chondrocranial-derived components of the cranial base.

48. Clinicians' Critical Thinking During Caries-Risk Assessment of Young WIC-Enrolled Children

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Objective: Early childhood caries (ECC) is a potentially painful and debilitating disease, which represents a significant public health problem among young children. The primary goal of this study was to assess the factors influencing the decision making of clinicians during the caries- risk assessment of children aged 0-48 months enrolled in the University of Iowa's Infant Oral Health Program (IOHP).

Methods: The charts of children aged 0 to 48 months (n=1,662) enrolled at the IOHP were reviewed for a cross-sectional study. Data was obtained from the child's baseline health history, clinical, and caries-risk assessment forms. Statistical analysis consisted of descriptive, bivariate, and logistic regression analyses (alpha=0.05) to assess the factors considered by clinicians while classifying a child as either low or high-caries risk.

Results: Of the 1,662 (48.2% females), 39.7% were classified as high-caries risk (mean age=24.6±11.5 months) while 60.3% (mean age=17.6±10.6 months) as low-caries risk. Bivariate analysis indicated children classified as high-caries risk were more likely to have non-cavitated and cavitated lesions (P<0.0001 in both instances), while logistic regression analysis indicated they were older (OR=1.06; P<0.0001), snacked 3 < times daily (OR=1.50; P=0.0085), co-slept with their mothers during the bottle- or breastfeeding (OR=1.76; P=0.0002), had inadequate fluoride exposure (OR=6.58; P<0.0001) and presence of enamel defects (OR=6.16; P=0.0002), as well as had mothers with no previous awareness of ECC (OR=1.48; P=0.0098) and language barrier (OR=1.56; P=0.0098).

Conclusion: Clinicians tended to classify children as high-caries risk based on children's clinical and dietary factors, as well as maternal ECC knowledge and language barrier.

49. Social Media Use by Dental Students for Dietary Information

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Objective: Understanding how social media influences dietary knowledge and behaviors of dental students is important, given that students provide dietary counseling for oral disease. Our objectives are to explore how dental students use social media to obtain food and nutrition information and their perception of content reliability.

Methods: All dental students (n=340) attending the University of Iowa's College of Dentistry were invited to participate. We developed a survey that was modeled after published surveys and piloted prior to administration. The survey queried demographics, professional and personal social media use, sites visited for dietary information and perceived reliability (i.e., trustworthiness) of information found on each site. The survey was administered using Qualtrix; students were given 3 weeks to complete.

Results: Students (n=101) were 70.7% female; mean±SD age was 24.6±3.3 years. Students identified as 25.7% first, 29.7% second, 25.7% third and 18.8% fourth year. 55% of students do not use social media for professional use, while 95% use social media for personal use, with 52% spending 1-2 hours/day on social media for personal use. Facebook is the most

visited social media site (94%) with 34% of students visiting Facebook 2-4 times/day. Google was the most used search engine for dietary information for professional and/or personal use (95%). For professional and/or personal use, 39% of students use PubMed, 25% use the Food and Nutrition Information Center (FNIC), 36% use ChooseMyPlate, and 46% use blogs/vlogs. Students classified information found on PubMed as 38% reliable, on FNIC as 22% reliable, on ChooseMyPlate as 32% reliable and on blogs/vlogs as 2% reliable.

Conclusion: Our results suggest that students use social media for personal more than for professional use, and recognize the unreliability of social media sites. It is unknown how their personal use of social media sources for dietary information influences their professional dietary counseling practices.

50. Patient Satisfaction With Dental Treatment at a University Dental Clinic: A Qualitative Analysis

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The aim for this study was to identify important factors influencing patient satisfaction in a university-based dental clinic, through qualitatively analyzing patient answers to an automated survey sent by the University of Iowa College of Dentistry. From 6/1/2014 to 1/30/18, 7,827 patient satisfaction surveys were collected. We conducted thematic analysis on the 10,956 patient responses to three open-ended questions: "What was the best thing about your experience with our clinic?", "Is there anything that you wish were different about our clinic?", and "Do you have any other comments or suggestions?". A thematic coding dictionary was inductively developed using content analysis using MAXQDA 2018 Standard, a qualitative data management software program. Any discrepancies were resolved through consensus and new codes or definitions of current codes were modified and applied. The finalized thematic dictionary included 12 thematic categories, developed from 52 working codes, and enabled the patient annotations to be grouped and sorted based on common themes to highlight significant aspects about the patient experience. Four notable themes that emerged from patient comments include: satisfaction with the emotional care (e.g. helpfulness, friendliness, empathy), satisfaction with skills and treatment provided by various personnel, dissatisfaction with the front desk and scheduling experience, and the high value patients place on clear communication about cost/insurance, treatment planning, waiting times, as well as the communication between departments, the dental student and the faculty, and the providers and the front desk. This research has taken highly valuable information and qualitatively analyzed it in a way that can help make positive changes within the college. With this data, we can emphasize areas for improvement and take steps towards making changes to enhance the patient experience. The analysis of the patient satisfaction surveys has the potential to move the College of Dentistry further in the direction of patient-centered care.

51. Preliminary Validation of a European Instrument to Measure Clinical Learning Environments for Dental Students (DECLEI) in Brazilian Dental Schools

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This study aimed to perform a preliminary validation for DECLEI in Brazil, thus providing guidance for a definitive validation study with a larger sample. A panel of three bilingual faculty members from the Federal University of Pelotas and one member from the University of Iowa College of Dentistry translated DECLEI into Portuguese, and assessed DECLEI's items relevance and content validity using the content validity index (CVI). DECLEI was then distributed to 155 7th- and 8th-semester dental students in the Spring 2018. The item-total correlation for the full scale was calculated and then items with relatively poor coefficients were eliminated. A cutoff of 0.30 or less was used. This process produced a 17-item scale, as well as a high Cronbach's α coefficient (0.86), demonstrating excellent reliability. There were no significant relationships with any of the 17 retained items and measures of age or sex, and there were too few non-white participants (n = 9) to make a valid comparison regarding race. However, significant differences were found when comparing 7th- and 8th-semester students. From a validity standpoint, these differences seem to make intuitive sense with what one would expect to see, i.e. 8th-semester students more strongly agreed that they could freely ask any question they had (p=0.038), and that their clinical teachers were approachable compared to 7th-semester students (p=0.002). Eighth-semester students were more likely to agree they were disappointed in their overall study experience (p=0.001), and that teachers were not adequately prepared for their class (p=0.013). Overall, these results could be evidence of "known-groups validity". Data presented here shows that DECLEI has

the potential to be used as a reliable instrument to measure clinical learning environments for Brazilian dental students using the scale produced by the item-total correlation.

52. Use of Hydroxy Acids for Etching: Dentin Adhesion and Collagen Degradation

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Objective: To test the use of hydroxy acids in the bonding procedure as alternatives to the aggressive phosphoric acid etchant.

Methods: Mid-coronal dentin surface of intact human molars was flattened with a carbide bur and etched with 35% phosphoric acid, glycolic acid, tartaric acid, gluconic acid, or gluconolactone for 15 sec (N=8/per group). OptiBond FL adhesive was applied to the dentin surface and teeth were restored with 5mm of resin composite (Filtek Supreme Ultra) applied incrementally and light-cured. Dumbbell-shaped resin-dentin beams were obtained and microtensile bond strength was measured. Failure pattern was also recorded and classified in adhesive, cohesive in composite, cohesive in dentin or mixed. For the collagen degradation, dentin beams (6mmx2mmx1mm) were obtained from intact molars and completely demineralized with the different etchants (N=10/per group). Mineralized beams were used as negative control. The percentage of change in dry weight before and after storage with incubation media at 37°C for 30 days was obtained. Statistical analysis was performed by one-way ANOVA and post-hoc Tukey-Kramer tests (α=0.05).

Results: The highest mean bond strength was observed for tartaric acid (57.03 MPa), with no statistical significant differences (p>0.05) to glycolic acid (52.77 MPa), phosphoric acid (50.69 MPa), and gluconic (49.03 MPa) acids. Demineralization with gluconolactone resulted in bond strength statistically significant lower than tartaric acid (p = 0.0133). Tartaric acid and gluconolactone etching resulted mainly in dentin and adhesive failures, respectively. Significant lower collagen degradation was observed for gluconolactone (2.28%) and gluconic acid (0.46%), while phosphoric (-13.79%) resulted in statistically significant higher collagen degradation when compared to other acids (p<0.05).

Conclusions: Use of glycolic and gluconic acids resulted in adequate bond strength to dentin and reduced collagen degradation and are potential alternative etchants to phosphoric acid in the bonding procedures.

53. Association of Catenin Alpha-2 (CTN-NA2) With Cleft Palate in Sub-Saharan African Populations

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Cleft palate only (CPO) is a congenital birth defect where the palate fails to fuse properly during embryonic facial development. CPO affects 1/500—1000 live births world-wide and imposes significant social and financial burdens on affected individuals and their families. The etiology of CPO is complex and likely results from a combination of genetic mutations with environmental covariates (Moreno et al., 2004). A recent genome wide association study for orofacial clefting (OFC) in Africa identified a novel locus near protein coding gene, Catenin Alpha-2 (CTNNA2), which was shown to be associated with risk of CPO in African populations (Butali et al., 2018). We sequenced the CTNNA2 gene in African CPO samples in order to find mutations that may provide potential explanations for CPO's missing heritability.

One rare missense mutation was found: p.Ser853Gly. The mutation was previously reported but had not been validated before this study. Bioinformatic analyses suggest high conservation of the wild-type residue. A structural inspection suggests that the mutation from serine to glycine would disturb the rigidity and binding function of the protein.

This study contributes evidence towards the suggestion that CTNNA2 mutations may contribute to risk of CPO in the African population.

54. Comfort and Beliefs Predict Students' Willingness to Treat Underserved Populations

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Objective: To identify which variables were significantly associated with dental students' willingness to treat 13 underserved populations 5 years post-graduation.

Methods: A survey was developed and distributed (2012-2014) to fourth year dental students at the University of Iowa (N=226). The survey queried students about their demographic characteristics, beliefs, and experiences working with underserved populations. Bivariate analyses were conducted for each of the 13 populations. Significant variables from the bivariate analyses within each population were considered for inclusion into each of 13 multiple logistic regression models respectively (alpha=0.05). IRB approval was obtained prior to commencing the study.

Results: 132 subjects (response rate=58%; 53% males) were included in the study. Logistic regression analyses revealed that the following variables were the most frequently statistically significantly associated with a willingness to treat underserved populations: the belief that once graduated, the participant will feel positive about treating that population (11 populations), strongly agreeing that dentists have a responsibility to treat underserved populations (7 populations), and currently feeling comfortable treating specific populations (6 populations). Participants who anticipated having positive feelings about treating specific populations were 2.73-7.05 times as likely to anticipate treating underserved populations compared to participants who anticipated having mixed or negative feelings. Participants who strongly agreed that dentists have a responsibility to treat underserved populations were 2.72-4.53 times as likely to anticipate treating underserved populations compared to participants who did not strongly agree. Participants who reported a comfort of "no problem" or "ok" treating underserved populations were 3.33-10.46 times as likely to anticipate treating underserved populations compared to participants who indicated some concern or stated they would rather not or would not treat underserved populations.

Conclusion: Providing dental students with opportunities to become more comfortable with underserved populations and emphasizing dentists' responsibility to treat them may increase students' likelihood to treat underserved populations post-graduation.

55. Characterization of *Streptococcus mutans* in a Dental College Population

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Objective: *Streptococcus mutans* (SM) is known to play a significant role in the development of dental caries. The objective of this project is to isolate SM from dental plaque collected from students at the University of Iowa College of Dentistry and conduct an analysis of SM genotypes detected in this relatively caries-free population. Through this project, we have begun to compile a library of SM strains from healthy subjects for potential future comparison to strains detected in populations with high rates of decay.

Methods: Sterile cotton swabs were used to collect whole mouth plaque samples from 18 students in the class of 2020 at the University of Iowa College of Dentistry. Samples were diluted and spiral plated onto MSKB (Mitis salivarius-Kanamycin-Bacitracin) agar for SM counts and isolation.. Identification of presumed SM isolates was confirmed by colony morphology and PCR targeting the gtfB gene. Genotyping was completed by AP-PCR (OPA2 primer). GelComparIIv6.5 software was used to analyze gels and create dendograms for isolate comparison.

Results: SM was detected in 66% (12/18) of students in this study. Only 3 SM genotypes were identified in this population. Individual subjects showed a range of 0-2 genotypes of SM, with genotypes A, B, and C present in 11% (2/18), 5.5% (1/18), and 61% (11/18) respectively. Two individuals of all subjects were colonized by 2 different genotypes.

Conclusions: Our results demonstrate relatively low diversity in SM genotypes with only 11% of subjects colonized by more than one genotype, and 33% with no SM present in this dental student population. This library of SM strains found in healthy subjects will be beneficial for future comparison to what is found in populations with much higher risk and incidence of caries.

56. Beverage Consumption Patterns in Early School-Aged American Indian Children

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Objective: Early childhood caries remains high among American Indian and Alaska Native children, and the role of diet and beverage consumption in caries formation is unknown. As we investigate this association, the objective of current

study was to assess beverage consumption in a group of early school age American Indian children.

Methods: Beverage consumption questionnaires were administered to parents of children included in the OST SMILeS Study Cohort in a Northern Plains tribal community. The questionnaire asked about the number of servings per week and ounces per serving for the following beverages: 100% juice, milk or milk-based products, soy milk, water and sugar-free beverages, and sugar-sweetened beverages such as regular soda, juice drinks, Kool-Aid®, and sports drinks. Beverage consumption data were recorded on paper forms, entered in Excel, and converted into SPSS format.

Results: One hundred seven parents completed questionnaires; the median age of the children was 7 years. All children consumed water and other sugar-free beverages, and nearly all consumed milk (87%) and 100% juice (86%). A majority consumed regular soda pop (58%) and powder-based sugar-sweetened beverages (54%). Water and other sugar-free beverages constituted the largest proportion of beverage amounts consumed (44%), followed by sugar-sweetened beverages (25%). The mean amount of sugar-sweetened beverages consumed per week was 119 ounces, while the median value was 68 ounces.

Conclusion: Results suggest sugar-sweetened beverage consumption is high in these American Indian children, and may contribute to high caries rates in this population.

Supported by: Delta Dental Foundations of South Dakota, Iowa and Wisconsin; The University of Iowa College of Dentistry Dental Student Research Program

57. Fracture Energy Assessment of the Mandible Computed Using CBCT

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Objective: The objective of this study is to validate that CBCT data can be used to compute an objective fracture energy and characterize that energy over different anatomical regions of the mandible. Furthermore, since medical CT scans have previously been used to assess fracture energy on long bones, there is a specific need to determine that CBCT can be reliably utilized for fractures of the mandible.

Methods: All fractures were grouped by 5 anatomical regions of the mandible. Fracture energies were computed for all the scans, and the fracture energy values were then compared between cases for which standard and CBCT scans were acquired. Additionally, the average fracture energy release rates for the

standard and CBCT scans were directly compared.

Results: The 37 subjects with 53 fractures were characterized as follows: 17 fractures of the condylar process, 3 fractures of the coronoid process, 12 fractures of the angle, 14 fractures of the body, and 7 fractures of the symphysis. Average fracture energy of all the fractures was 2.1 Joules (J) with standard deviation of 1.66 J. Maximum fracture energy was 7.7 and minimum was 0.3 J.

Conclusions: Fracture energy scores can be computed for mandibular fractures using CBCT. This suggests the possibility of implementing an objective scale for fracture severity of mandibular fractures. As a future work, an additional 16 CBCT samples will be gathered to increase the overall sample size to a total of 53 samples. Once the outcomes of this study are successfully achieved, an association between post traumatic osteoarthritis in the temporomandibular joint will be investigated.

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

58. Effect of Four Cardiac Hormones on Oral Squamous Cell Carcinoma Proliferation

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Cardiac natriuretic peptides are known for playing a key role in the control of blood pressure. They have also shown ability to control the growth of several solid tumors including human pancreatic adenocarcinoma, human breast cancers, and small-cell lung cancer *in vitro* and *in vivo*.

Objective: The objective of this study was to investigate the effects of four cardiac hormones, namely, atrial natriuretic peptide (ANP), long-acting natriuretic peptide (LANP), vessel dilator (VD) and kaliuretic peptide (KP) on controlling the growth (proliferation) of oral squamous cell carcinoma cells (OSCC) *in vitro*.

Methods: Dose-dependent experiments were carried out using two oral squamous cell carcinoma (OSCC) cell lines (SCC9 and SCC25). Triplicates of each cell line were seeded in 96-well plates, allowed to attach for 24h, starved overnight and then treated with the four hormones at concentrations of $1\mu M$, $10\mu M$, $100\mu M$ and $1000\mu M$. MTS assay was performed at an incubation time 24h in order to determine the effect of each peptide on the OSCC cells. For all tested hormones, $1000\mu M$ was the most effective concentration.

Results: For all tested hormones, $1000\mu M$ was the most effective concentration. Regarding the cardiac hormones, VD, LANP, KP and ANP were able to reduce, respectively, 42%, 48%, 34% and 53% of SCC9 cells and 36%, 41%, 27% and 33% of SCC25 cells, compared to untreated cell lines.

Conclusions: Future experiments are ongoing to assess the effect of these cardiac hormones on apoptosis and cell cycle in order to provide more insight about their mechanisms of action and possible use as therapeutic agents in OSCC.

59. Post-Graduate Geriatric Dental Curriculum in the United States

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Objective: To compare the geriatric dentistry curricula between Advanced Education General Dentistry (AEGD) and General Practice Residency programs.

Methods: A 108-item survey was developed to assess residents' didactic and clinical experiences treating geriatric patients. Surveys were mailed in July 2018 to all AEGD and GPR programs (N=269; 89 AEGD and 180 GPR). Descriptive analyses were performed. Bivariate analyses were conducted using the chi-square, Fisher's exact, and Wilcoxon rank sum tests (alpha=0.05). IRB approval was exempt.

Results: Sixty-two program directors completed surveys (17 AEGD and 45 GPR; response rate=23%). Sixty-seven percent of programs reported mandatory didactic training pertaining to frail and functionally dependent geriatric adults. Programs spent the most time teaching treatment considerations and adapting treatment plans for geriatric patients. Ninety-eight percent of AEGD and GPR programs reported residents provide treatment to geriatric patients, with 18% of all programs providing nursing home care. Bivariate analyses showed GPR programs were more likely than AEGD programs to report mandatory clinical experiences in hospitals (91% vs. 56%; p=0.0057) and operating rooms (86% vs. 38%; p=0.0002). AEGD and GPR programs were most likely to provide extractions and restorations and least likely to provide implant placement, implant restorations, and silver diamine fluoride (SDF) applications for frail and dependent geriatric patients. AEGD programs were more likely than GPR programs to utilize SDF among this population (33% vs 7%; p=0.0218). Considering all patient encounters, 64% of GPR programs reported often treating patients using IV bisphosphonate versus 29% of AEGD programs (p=0.0313), and 52% of GPR programs reported often treating patients undergoing chemotherapy versus 15% of AEGD programs (p=0.0259).

Conclusions: Although both AEGD and GPR programs reported treating geriatric patients, GPR programs reported treating more medically complex patients than AEGD programs. GPR programs were

more likely than AEGD programs to report hospital and operating room experiences.

60. Factors Associated With Altruistic Attitudes in Dental Students and Residents

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Objective: Behaviorally compassionate providers are central to reducing disparities in access to dental care. This exploratory study examines altruistic attitudes of dental students and residents to identify whether certain personal characteristics predispose students towards altruism.

Methods: This cross-sectional study targeted a convenience sample of current (2017-2018) D1—D4 dental students and residents at the University of Iowa College of Dentistry. A 31-item web-based survey was designed after a thorough literature review. Altruism was assessed using 8 items developed and validated in previous studies. This survey was administered through RedCap and distributed through the student email listserv. Descriptive statistics and bivariate comparisons (Pearson's r and t-tests) were made between personal characteristics and level of altruism, as measured by agreement with the 8 attitudinal statements.

Results: As of January 2019, 83 surveys had been returned. An exact response rate could not be calculated due to the nature of the email listserv. Female students demonstrated significantly higher altruistic attitudes about societal expectations regarding access to care than male students (p=0.02). Females also reported higher mean levels of personal responsibility for providing dental care to the needy (p=0.05). Students who grew up in an urban community reported significantly higher levels of personal (p=0.03) and professional responsibility (p=0.04) towards underserved populations than students without an urban background. There were no significant differences between altruistic attitudes and any of the following variables: class, history of community service, marital status, source of dental school funding, membership in a marginalized community, or rural upbringing.

Conclusions: This study gives insights into factors that may help in recruiting dentists to serve vulnerable populations. Contrary to popular belief, these findings indicate that students from urban areas rather than rural communities may be more predisposed towards altruistic attitudes and behaviors.

61. Identifying Variants Contributing to Nonsyndromic Orofacial Clefts in Dachshund Family Transcription Factor 1 Gene in Multiple Populations

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Orofacial clefts are the most common craniofacial malformation in humans, occurring in about 1 out of every 700 births worldwide. The causes of orofacial clefts are complex, with race, ethnicity, geographic locations, environment factors, and socioeconomic status all contribute to the incidence of this disease. The goal of this project was to identify variants in the Dachshund Family Transcription Factor 1(DACH1) that could contribute to the development of nonsyndromic orofacial clefts. The DACH1 gene was recently identified through the first African Clefts Genome-Wide Association Study (GWAS) as highly associated with individuals with nonsyndromic orofacial clefts. We preformed Sanger sequencing of the DACH1 gene in 192 individuals from Africa with nonsydromic cleft palate only and 91 individuals from the Philippines with nonsyndromic cleft lip and palate. We found a previously identified missense variant with an observed frequency of .03, compared to a reported frequency of <.0001, that was predicted as deleterious (low confidence) and possibly damaging by SIFT and PolyPhen bioinformatic tools, respectively. This missense variation changes the protein sequence of the DACH1 gene and, according to HOPE bioinformatic tool, could change the folding and function of the protein by exchanging the smaller amino acid Glycine with the larger Serine. We have identified a variant, enriched in our population, that may have something to do with orofacial clefts, but we have not yet fully explained the biology of that variant, which requires further research. We hope that our finding will lead us to a more complete understanding of the complex etiology of orofacial clefts and give us the tools to reduce the negative psycho-social impact of orofacial clefts on individuals affected and their families.

62. Caries Increment in Children Following Application of Silver Nitrate or Silver Diamine Fluoride: A Retrospective Study

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Objective: Prevention of dental caries among children is still an important issue. In recent years, Silver Nitrate (SN) and Silver Diamine Fluoride (SDF) have been used to arrest dental caries activity and prevent further decay development. However, limited evidence exists on which method is superior in preventing caries development. This study aims to determine if there is a difference in caries increment scores between SN and SDF, and factors associated with caries increment.

Methods: This retrospective study looked at the records and radiographs of 84 children aged 2-15 years with carious lesions treated with SN or SDF at a private pediatric dental office. Caries increment score was measured as the change in DFT/dft in each subject from baseline to a follow-up visit up to a year later. DFT/dft scores were determined by chart review using data recorded at the two visits. Statistical analysis consisted of descriptive statistics, paired-sample t-test, Wilcoxon signed-rank test, Wilcoxon rank-sum test, chi-square test, and Fisher's exact test (alpha=0.05).

Results: The 84 study subjects included (51.2% female) were on average 5.6 ± 2.4 years old and had 21.3 ± 2.2 teeth at baseline. Of the 78 subjects treated with SN, 73% had no caries progression, while the 6 subjects treated with SDF, 66.6% had no caries progression. Both SN and SDF showed no significant change in DFT/dft scores (p=0.3706 and p=0.6109, respectively). There was no significant difference in change in DFT/dft scores regarding gender, age, number of teeth, and selected risk factors (p> 0.05 in each instance).

Conclusions: For children treated with SDF or SN, there was no difference in caries increment. Additional data is needed to determine whether SN or SDF is more effective in reducing caries increment, including adding more variables and increasing the sample size of subjects with SDF.

63. Caries Progression Following Treatment With Silver Diamine Fluoride and Silver Nitrate: A Radiographic Retrospective Study

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Background and Objective: Silver nitrate (SN) and Silver Diamine Fluoride (SDF) are products that hold promise for management of dental caries. The purpose of this study is to investigate the caries arresting qualities of SN and SDF in children over a period of time utilizing radiographic analysis.

Methods: This is a retrospective study of 75 children aged 2-10 years with carious lesions treated with either SN (n=69) or SDF (n=6) at a private dental office. Bitewing radiographs taken on the date of initial SN/SDF application and at the one-year follow-up visits were evaluated for caries progression. Radiographic progression of interproximal carious lesions was measured, and associations of caries progression with child demographic and clinical characteristics were examined. Statistical analysis consists of Wilcoxon signed-rank test, Wilcoxon rank-sum test, chi-square test, and Fisher's exact test (alpha=0.05).

Results: Seventy-five subjects (53.3% females), comprising 380 teeth with 197 distal surfaces and 183 mesial surfaces of primary molars were treated with either SN (n=355 teeth) or SDF (n=25 teeth), were included in the study. Distal surfaces treated with SDF and mesial surfaces treated with SN or SDF showed no significant caries progression from baseline, while distal surfaces treated with SN showed significant caries progression (p=0.0078). Moreover, caries progression was not statistically significantly associated with age, gender, type of treatments, plaque, previous restorations, caries risk assessment category, insurance type, tooth type (1st vs 2nd primary molar) and tooth surface (distal vs mesial). The majority of distal (n=188, 95.34%) and mesial (n=113, 61.75%) tooth surface lesions showed no progression.

Conclusions: There was no statistically significant caries progression with SN or SDF application at tooth surfaces except for SN at distal surface. Additionally, no significant difference in caries progression was found between 1st and 2nd primary molars or primary molar tooth surfaces.

64. Community Size and Dentist Acceptance of Public Dental Plans

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Objective: In 2014, Iowa introduced the Dental Wellness Plan (DWP 1.0), a dental care plan for low income adults not currently enrolled in Medicaid. In response to concerns about plan structure, this plan was modified in July 2017 (DWP 2.0). This study focused on exploring the relationship between city population size and changes in dentist participation from DWP 1.0 to DWP 2.0.

Methods: This study used data from a survey of Iowa private practice dentists conducted in December 2017, which assessed dentist participation in, and satisfaction with, DWP and Medicaid. Dependent variables were dentist participation (i.e., acceptance of new patients) in DWP (1.0 and 2.0), participation in Medicaid at both time points, and change in participation. The key independent variable was city population size. Additional predictors of interest included dentist demographic and practice characteristics. Bivariate analyses examined associations between independent and dependent variables.

Results: 22% (n=305) of private practice dentists participated in the survey. Overall, the proportion of self-reported dentist participation decreased from 67% in DWP 1.0 to 40% in DWP 2.0. Medicaid participation also decreased from 65% to 55% during the same time period. Dentists in smaller cities were significantly more likely than those in larger cities to participate in DWP 1.0 (p=0.01); no association was seen with participation in DWP 2.0. Dentists in smaller cities were also significantly more likely to participate in Medicaid before (p<0.01) and after (p=0.02) DWP 2.0 was implemented. Community size was not associated with change in participation in either program.

Conclusions: The introduction of DWP 2.0 resulted in decreased dentist acceptance of both DWP and Medicaid patients. Practices in smaller Iowa cities were more likely than those in larger cities to accept DWP 1.0 and Medicaid, but no difference was noted for DWP 2.0.

65. Variation in the Dachshund Family Transcription Factor 1 and Dickkopf WNT Signaling Pathway inhibitor 1 contribution to Nonsyndromic Orofacial Clefts

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Nonsyndromic orofacial clefts occur worldwide in 1 of 700 births with various factors such race, ethnicity, socioeconomic status, environment, and geographic location; influencing its incidence. However, the etiology of clefting is still not fully understood. Individuals can be affected with cleft lip and palate (CLP) or cleft palate only (CPO). The goal is to identify variations within the Dickkopf WNT Signaling Pathway Inhibitor 1 (DKK1) and Dachshund Family Transcription Factor 1 (DACH1) genes and determine their association with nonsydromic clefting. These genes were identified as having significant association with clefting through a genome-wide association study (GWAS) in Africans. Sanger sequencing was conducted on DKK1 96 individuals from Iowa and Puerto Rico, 288 individuals from Africa (combination of Ethiopia, Nigeria and Ghana) with CLP, and 192 individuals from Africa with CPO. Sanger sequencing was also done on DACH1 on 96 individuals from Iowa. A novel missense mutation was found in DKK1 in an individual from Ghana associated with CLP changing the amino acid sequence from serine to asparagine. A bioinformatics tool, Ensembl, analyzed this mutation and determine it as most likely tolerated. HOPE reports it may lead to a loss in hydrophobic interaction. A known missense mutation in the DACH1 gene was also observed in the Iowa samples at a frequency of 0.0116, compared to a reported frequency of 0.000804 within the American population and a p-value < 0.05. This mutation is predicted to be possibly deleterious and damaging using Ensembl. The mutation changes the amino acid sequence of this protein from an arginine to a cysteine. These variants found show an association with nonsyndromic orofacial clefts however further investigation is required to explain biological effects. Further research within gene variation may lead to future reduction and education of orofacial clefting to improve the lives of families and individuals at risk.

66. Caries Risk Assessment Factors and Dental Caries Experience in Children

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Objective: The objective of this project was to investigate the relationships between caries risk assessment (CRA) factors and dental caries experience among children visiting the University of Iowa Pediatric Dental Clinic (UIPDC).

Methods: Data was collected via a retrospective chart review of patients presenting for an initial dental examination performed by third-year dental students, from 01/01/2017-08/01/2018 in the UIPDC. CRA information was collected using the CRA form completed at the initial dental examination. Dental caries experience was defined as cavitated and/or non-cavitated lesions present upon examination. Bivariate and logistic regression analyses were performed to explore statistically significant relationships between dental caries experience and a set of risk factor variables (alpha=0.05).

Results: A total of 409 subjects (46.2% without dental caries experience and 51.1% female) who fulfilled the inclusion criteria were included in the study. Bivariate analysis revealed that subjects with dental caries experience were likely to be older (mean age: 9.9 ±3.9 years vs 7.5 ±4.5 years; P<0.0001), have a parent or sibling with dental caries experience (P<0.0001), have their teeth brushed less than one-time per day (P=0.0033), have inadequate fluoride (P=0.0009), and between meal cariogenic snacks more than two-times per day (P=0.0057). Logistic regression analysis showed that older subjects (OR=1.08; P=0.0118), subjects who had previous restorations in the primary dentition (OR=2.50; P=0.0187), poor oral hygiene (OR=6.18; P<0.0001), cariogenic beverages more than two-times per day (OR=2.29; P<0.0001), and irregular dental care (OR=2.28; P=0.0015) were significant factors for dental caries experience. Additionally, results indicated that the odds of having dental decay increased 8% as age increased by 1 year (OR=1.08, 95% CI: 1.02-1.15; p=0.0118).

Conclusion: Results of the study suggest that several of the CRA factors were significantly associated with dental caries experience. Efforts to promote education regarding good oral hygiene, fluoride, and limiting cariogenic snacks and beverages should be continued.

67. Reporting of Statistical Non-Significance in Randomized Controlled Trials in Dentistry

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Objective: Well-conducted randomized controlled trials (RCTs), with their low degree of bias, are the gold standard study design for evaluating clinical interventions. The aim of this study was to investigate the reporting of non-significant results for primary outcomes in RCTs published in high-impact dental journals.

Methods: A search was conducted within the top ten ranked journals per Eigen Score to retrieve RCTs on human subjects published in English in 2015. Two calibrated investigators screened 1,450 articles retrieved from the search. The primary outcome of this study was the explicit reporting of a non-significant result (p>0.05) for the primary interarm outcome either, directly addressing the main objective or by sample size calculation. Secondary variables extracted included journal name, journal impact factor, corresponding author's country, international collaborations, source of financial/material support, and number of treatment arms.

Results: Two hundred and sixty-four RCTs were included for assessment, of which 106 (40.2%) were subsequently excluded after evaluation due to the following criteria: 1) unclear primary outcome, 2) multiple primary outcomes, 3) unreported p-value, or 4) non-inferiority trial. Of the included 158 RCTs with well-defined primary outcome, a non-significant result for the primary interarm outcome was reported in 76 (48.1%) RCTs.

Conclusions: Almost half of the included RCTs published in high-impact dental journals in 2015 with a well-defined primary outcome had reported a non-significant result (p>0.05). This measure suggests a healthy publication environment among high-impact dental journals.

68. Preliminary Validation Study of a Novel Ageism Scale Designed for Dental Students in Brazil

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Objective: Ageism (age discrimination) is pervasive and has a negative impact in elderly health care. This work reported on a preliminary validation study of a novel scale for assessing ageism among dental students in Brazil. An appropriate scale for dental students can provide information that helps addressing potential biases or attitudes when treating an older population.

Methods: A novel 27-question scale was generated by a panel of geriatric dentistry faculty members from different universities, based on existing scales aimed to other health professionals, and translated to Portuguese. The scale was then applied to a sample of 155 dental students at the University of Pelotas in Brazil. A panel of five Brazilian faculty members revised the scale until achieving consensus to establish content validity. Then, Principal Component Analysis was used to assess internal structure of the measure. Questions whose deletion increase the overall a, loading < 0.40, loading on more than one factors or those unexpectedly grouped in another factor were thoroughly examined.

Results: Analysis of the initial 27-item scale resulted in 12-item final scale with 3 components that accounted for 51% of overall variance. Component 1 (6 items) contained items presenting a negative view of elderly patients with items such as "Elderly patients are better off in nursing homes" and "Elderly patients usually do not comply with dental advice". Component 2 (3 items) contained items dealing with the complexity of providing care such as "It is too costly to provide out of office dental care to homebound elderly patients." Finally, component 3 contained three items that would reflect less ageism the more positively a student endorses them such as "I tend to pay more attention towards my elderly patients than my younger patients."

Conclusions: This preliminary analysis resulted in a 12-item Brazilian scale with 3 components with reasonable reliability.

69. Phenotypic Spectrum of Enamel Defects in Nonsyndromic Orofacial Clefting

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Objective: Children with oral clefts often show a wide range of dental anomalies, adding complexity to understanding the phenotypic spectrum of orofacial clefting (OFC). Enamel defects such as hypoplasia and hypocalcification occur at an increased frequency in individuals with OFC. Prior studies show conflicting results regarding the location of these defects within the clinical crown and whether such location can be related to the development of a cleft defect or corrective surgical procedures. This study characterizes the developmental location of hypoplasia and hypocalcification in a U.S. sample of children with nonsyndromic OFC compared to controls and will assist in understanding the underlying etiology of such enamel defects to help provide early interventions, reduce adverse effects, and improve treatment outcomes.

Methods: This study included 198 individuals recruited in the U.S (Iowa, Texas, and Pennsylvania) as part of an NIH funded multicenter OFC study (Marazita, PI), 106 case-probands affected with OFC and 92 control-probands. Hypocalcification and hypoplasia were identified using intraoral photographs and scored using an electronic intake form. Defects were classified as occurring in the incisal, middle, and/or cervical thirds of clinical crowns in primary and permanent dentitions. Hypocalcification was further defined as diffuse or demarcated. Case-control differences were assessed using Fisher's Exact test and Holm correction.

Results: Case probands showed significantly more diffuse-hypocalcification in the permanent dentition in teeth #4 (p-value=0.0007), #5 (p-value=0.0003), and #12 (p-value=0.0106) on the lingual incisal one-third of the clinical crown compared to controls. No case-control differences were found for hypoplasia or the primary dentition. No significant differences were found by sex or cleft type for all enamel defects.

Conclusions: Collectively, these findings indicate that individuals with OFC have more diffuse-hypocalcification in the incisal one-third of permanent maxillary premolars, corresponding to 18-43 months after birth, suggestive of a developmental disturbance which may correspond to corrective surgery.

70. Genotype Profiles of Lactobacilli From American Indian Children

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Objective: Early childhood caries (ECC) is a debilitating oral disease that demands the attention and awareness of the general public, dental professionals, and researchers, alike. Unfortunately, American Indians and Alaska Natives have been noted as the two racial groups with the highest rates of early childhood caries. We are currently investigating the presence of lactobacillus and the spectrum of genotypes of lactobacilli (LB) in American Indian (AI) children from a Northern Plains Tribal Community. We report here on genotypic diversity of lactobacillus species isolated from a subset of children in this population (n=20).

Methods: Whole mouth plaque samples were collected from AI children from birth to 36 months of age. Samples taken at 36 months of age were diluted and spiral plated onto Rogosa agar plates for determination of LB counts. Ten LB colonies were isolated from the 20 children with the highest LB counts. LB isolates were genotyped by arbitrarily primed PCR (AP-PCR) using primer 272. Genotypic diversity was assessed by generation of dendrograms using GelCompar IIv6.5 software (Applied Maths, Austin, TX, USA). Curve based cluster analysis using the Pearson correlation and Unweighted Pair Group Method using Arithmetic Averages (UPGMA) was used to assess strain relatedness. Lactobacilli isolates displaying greater than 70% similarity were considered to be the same genotype.

Results: 34 lactobacillus genotypes were observed in this population. Individual children displayed a range of 1 to 6 LB genotypes. 19 genotypes were identified in only 1 child.

Conclusions: We observed differences in disease burden in children based on the mother's lactobacillus status. A large amount of LB genotypic diversity was observed in this subset of AI children. Additional analyses will enable us to determine what specific species of lactobacilli are present and if any associations with LB and severity of disease occur.

71. Do Dental Students' Attitudes Predict Actual Treatment of Underserved Populations?

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Objective: To determine whether dental students' predictions about their willingness to treat underserved populations as dentists is accurate post-graduation.

Methods: A questionnaire was developed to assess dental students' anticipated willingness to treat 13 underserved populations 5-years post-graduation. A similar survey with a few of the same questions was developed to assess which populations the same students are now treating as alumni. Each student was assigned an identifying code so that their answers could be linked to each year they were in school (D1-D4 years; Classes of 2011-2013; N=240) and to their answers as a practicing dentist. A Cohen's Kappa statistic was used to evaluate the degree of agreement between the students' and alumni's responses (alpha=0.05). IRB approval was obtained.

Results: 46 alumni returned surveys for an adjusted response rate of 22%. Fair agreement was noted between student and alumni responses pertaining to the following populations: D1-jail inmates (kappa=0.24); D2-homebound (kappa=0.29) and medically complex (k=0.20) patients; D3-no agreement; D4-low income (kappa=0.25) and medically complex (kappa=.25) patients. With the exception of treating patients with Medicaid, when agreement was not noted, alumni behaviors were often more positive than anticipated. More than 90% of respondents reported treating the following populations: frail elderly, medically complex, mentally compromised, other ethnic groups, known drug users, patients with HIV+/AIDS, and non-English speaking patients.

Conclusion: Preliminary findings suggest that dental students' predictions about whom they will treat post-graduation may not accurately predict future behavior.

72. Acidogenicity and Acid Tolerance of Oral Streptococci Obtained From Dental Plaque

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Objective: The recovery of plaque bacteria on solid media of pH5 or 5.5 has been used to estimate caries risk. However, in our previous work the proportions recovered did not correlate with caries status. One explanation is that acidogenicity is not strictly correlated with acid tolerance. This study, albeit limited to oral streptococci, investigated how well acidogenicity correlates with growth on low pH media.

Methods: Dental plaque from 13 children was collected. Thirty streptococcal strains were obtained from each sample. Acidogenicity of each strain was determined by measuring the terminal pH after overnight growth in chemically defined medium (CDM) and Brain Heart Infusion (BHI) broth. For acid tolerance, each isolate was subcultured onto solid media of pH 7, 5.5, 5.25, 5, 4.8. The lowest pH on which growth occurred was recorded. Spearman's rank correlation test was used to measure the strengths of association of acid tolerance with terminal pH.

Results: When all strains were considered collectively, there was a weak but statistically significant correlation of acid tolerance with terminal pH in BHI or CDM (r=0.10, p=0.0469 or r=0.24, p<0.0001; respectively). When strains were examined by subject, however, the results were highly variable. Strains that grew on media of pH 4.8 were more likely to be recovered from caries subjects than caries-free subjects, and 7 of the 8 subjects that had isolates that grew on media of pH 4.8 harbored mutans streptococci or other low pH streptococci.

Conclusion: The results show only a weak correlation exists between acidogenicity and acid tolerance among plaque streptococci isolated from children. This correlation is highly variable from one individual to the next indicating that growth on low pH media may not be a reliable indicator of the presence of highly acidogenic and cariogenic streptococci unless the pH of the solid medium is less than pH 5.

73. Prevalence of Pediatric Dental Treatment Completed Under General Anesthesia Among American Indian Children in Northern Plains Tribal Community

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Objective: To evaluate patterns of treatment under general anesthesia (GA) due to dental caries among American Indian children from a Northern Plains tribal community.

Methods: As part of a longitudinal study, mothers who had recently given birth were recruited and follow up visits were conducted when children were 1, 4, 8, 12, 16, 22, 28, and 36 months of age. Another follow up was performed at age 6-7 years, and for this visit, pediatric dental records were collected and evaluated. Specifically, information regarding the date of each dental visit, the extent of treatment and whether the treatment was completed under GA were recorded. Data were converted into SPSS format to generate descriptive statistics.

Results: Data were obtained from 117 children and dental records of 95 of those individuals were collected. The age range of the visits to the pediatric dental office varied from 5 months to 8 years, 4 months. Of the 95 children that had been seen, 83.2% received dental treatment under GA at least once. 25.2% received dental treatment under GA two or more times. The youngest child that was treated under GA was 15 months old.

Conclusion: A large majority of American Indian children in a Northern Plains Tribal Community received dental treatment under GA; many were treated under GA multiple times which emphasizes the high prevalence of caries in this community. Given the high cost of this treatment, even modestly effective preventive strategies could yield cost savings.

74. Dental Student Stress and the First Year Curriculum

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Objective: Dental students have identified academic issues as the most significant stressors in dental education. However, the relative contribution of different academic elements to student stress is not established. The primary purpose of this study was to examine how components of academics related to stress. This survey used a modified Dental Environment Stress (DES) questionnaire to investigate student reporting of stress by category at The University of Iowa, as well as a similar questionnaire to identify associations of student stress scores and individual curriculum events in the first year of dental school.

Methods: Survey data were from 25 students (31.25% response rate) after completion of their first year of dental school at The University of Iowa. The survey included three parts: 1) a revised Dental Environment Stress (DES) survey evaluating 44 stressors using a 0-4 Likert scale, 2) a survey encompassing all 66 assessment types in the first year dental school curriculum using the same scale, and 3) a free response section for students to list and describe their perceived 3 most and 3 least stressful courses. Questionnaire results were analyzed by DES category, course, weight, assessment type and proximity to other courses.

Results: 'Academics' was the most significant stressor category (2.61±0.63) with highest item being Examinations and Grades. Half of the highest ten DES items fell into the 'Academics' category. Stressors related to time also appeared in high scoring items. 'Interpersonal Issues' was the lowest stressor category (1.20±0.49) with the lowest items being stress related to discrimination or harassment. High stakes assessments had significantly higher stress scores than low stakes assessments.

Conclusions: The results of this study support current studies identifying academics as the most substantial stressor in dental school, and provide further insight into the specific types of assessments that are most significant in generating student stress.

75. Maxillary Arch Variation in Relatives of Individuals With Orofacial Clefts

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Objective: Children born with orofacial clefts (OFCs) often present with upper arch anomalies including tooth size-arch length discrepancies and arch shape irregularities leading to malocclusion. However, little is known if such anomalies are also seen in first degree relatives of individuals with overt clefts whom are seemingly unaffected yet may share OFC risk. This study aims to test for phenotypic differences in upper arches of unaffected family members of individuals with OFC (Cases) compared to controls with no history of OFC.

Methods: Maxillary casts of 760 individuals were created and scanned using a NextEngine Laser scanner and digitized by two raters with 92 landmarks covering gingival margins and occlusal surfaces via Landmark Editor software. An inter-rater agreement error of less than 1mm was obtained (reliability=88.15%) for all 92 landmarks. 3D coordinates were extracted and registered using a Procrustes fit procedure. Procrustes residuals were analyzed via canonical variate analyses to capture differences in 3D shape between cases and controls. Of the 760 individuals attempted, 535 (Cases N=133, Controls = 402) had all 92 landmarks and 688 (Cases=192, Controls =496) had at least 40 landmarks in the canine to canine region. Thus analyses were done separately for each subsample.

Results: Case-control differences were not significant (P=0.11) for overall dental arch shape. However, for the canine to canine dataset, significant case-control differences were found (P=0.0213 for raw Procrustes distance, P<0.0001 for Mahalanobis distance). Cases had maxillary anterior dentitions that were more retrusive overall with smaller and outward angled canines and narrower central and lateral incisors with larger embrasures when compared to controls.

Conclusions: Anterior arch shape significantly differs between unaffected relatives of individuals with OFC and controls. The phenotypic differences identified in this study contribute to the understanding of the cleft phenotypic spectrum aiding future studies of cleft etiology and cleft risk prediction.

76. The Relationship Between Behavior of Children and the Success of Medical Management of Caries Using Silver Diamine Fluoride Or Silver Nitrate: A Retrospective Study

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Objective: Despite advances in dental technology and materials, caries rates have remained steady in children. Promising medicaments to slow caries are 25% Silver Nitrate (SN) and 38% Silver Diamine Fluoride (SDF). The objective for this study is to determine if cooperation changes with the use of SN/SDF.

Methods: This study looked at records and radiographs of 88 children aged 2-16 years with carious lesions that were treated with either SN or SDF at a private dental office in Coralville, IA between April, 2014 and April, 2018. To assess behavior, the record of each subject was examined for both the initial visit as well as the follow-up. Behavior was recorded as either cooperative or uncooperative as indicated in the record by the treating dentist. Data were analyzed at baseline and one-year follow-up. Descriptive statistics were applied for patients' demographic and clinical characteristics. The association of behavior and other variables of interest was assessed using chi-square test, Fisher's exact test, and nonparametric Wilcoxon-Man-Whitney test. The change in the behavior between initial and follow-up treatments was compared using McNemar's test.

Results: Eighty-eight subjects were treated with either SN or SDF. 86.3% had no change in behavior from baseline to follow-up. Of the 12 subjects with changed behavior, 10 had better behavior and 2 had worse behavior, indicating a significant change in behavior rating between the two visits (p=0.0209), At both the baseline and follow-up visits, age, gender, type of treatments, calculus, plaque, previous fills, caries risk assessment category, and number of teeth were not statistically significant in association with behavior rating.

Conclusions: Children's behavior improved at follow up visits after receiving SN/SDF treatment. The behavior was not associated with other factors such as age, gender, type of treatments, calculus, plaque, previous fills, caries risk assessment category, and number of teeth.

77. Simulated Body Fluid Mineralized Matrices Embedded With Non-viral Gene-based Growth Factors for Bone Tissue Engineering

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Objective: Development of synthetic material for bone tissue regeneration will alleviate the issue of rapidly increasing demand for bone grafts. Calcium phosphate coatings have been shown to provide a cell compatible surface that is osteoinductive, and non-viral gene delivery has been a promising method to induce osteogenesis *in vivo*. We hypothesize that combining calcium phosphate coatings and non-viral gene delivery in a single scaffold will further enhance bone regeneration as compared to either treatment alone.

Methods: 3D collagen scaffolds were cut from Collagen Plugs, and the mineralization process was carried out for 30 days in simulated body fluid (SBF). During the mineralization process, PEI-DNA complexes were incubated with SBF to co-precipitate complexes into the mineral layer. Scanning electron microscopy (SEM) and energy dispersive spectroscopy (EDS) were used to characterize the calcium phosphate coating. To test the prepared scaffolds *in vivo*, 5 mm diameter defects were created in the cranial bone of Fisher 334 rats. After implantation, scaffolds were imaged using micro-CT and visualized through histology.

Results: The mineralized collagen scaffolds were prepared using SBF immersion. SEM showed plate-like calcium phosphate crystal growths on the collagen, and EDS analysis revealed a calcium phosphate ratio of 1.67 which is similar to calcium deficient hydroxyapatite. Rat calvarial defects treated with the CAp-GAM contained significantly more bone compared to collagen scaffolds based on micro CT analysis. Additionally, histology revealed callus formation was significantly increased with the addition of the mineralized GAM.

Conclusion: The work presented suggests mineralization and incorporation of gene therapeutic agents in a collagen scaffold resulted in enhanced new bone formation over the collagen scaffold alone, thus this work provides the basis for future investigations of CAp-GAM in bone tissue engineering.

78. Effects of Gold-Poly-L-Lysine Nanocomplexes Incorporation in Dental Pulp Stem Cells for Micro-CT Analysis

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Objectives: Tissue engineering is an interdisciplinary research field that associates stem cells, growth factors and biomaterial scaffolds as a therapeutic strategy to restore biological functions. Its advancement has resulted in the development of new treatment opportunities in biomedical areas, including pulpal regeneration in dentistry. However, despite the innovations, the methods of evaluation still demand the use of histological slices, with some limitations such as the non-observation of the behavior of the cells and scaffolds in three-dimensional form. Therefore, this study aimed to assess the feasibility of dental pulp stem cell loading with gold nanoparticles complexed with Poly (L-lysine) (AuNP-PLL), for cellular tracking in a three-dimensional analysis by micro-CT. For this,

Methods: DPSC were cultured and incorporated with AuNP-PLL (0.2 mg/ml) and assessed for cell viability (24h, 48 and 72 hours after incorporation) and apoptosis/dead index (24 hours after incorporation). Incorporated cells were also observed under micro-CT scanning.

Results: AuNP-PLL labeling does not affect cellular viability in any periods analyzed or interfere on the apoptosis/dead index of DPSC. Labeled DPSC can be clearly visualized *in vitro* with a micro-CT scanner, with a radiopacity greater than the control group (non-incorporated cells).

Conclusions: Taken together, these results indicate that it is possible to incorporate AuNP-PLL complex into DPSC and track the cells by using Micro-CT; furthermore, this incorporation of 0.2mg/ml of AuNP-PLL does not interfere in the DPSC basic behavior. In addition, this approach could be a useful tool for cellular labeling for the observation of cells behavior and the interaction of the cells and scaffolds in a three-dimensional way, which could lead to the development of new approaches in the pulpal regeneration in dentistry.

79. Spontaneous Healing of a Buccal Bifurcation Cyst: A Case Report

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Objective: The buccal bifurcation cyst, is an uncommon odontogenic cyst that is associated with mandibular permanent molars. Histopathologic features are not distinctive, making diagnosis dependent on clinical and radiographic findings. Molar vitality and buccal tilting of the crown is evident in most cases. Radiographically it usually presents as a radiolucent lesion on the buccal aspect of the tooth. The apices of the roots are tilted towards the lingual cortex of the mandible.

Results: A 15 year-old female presented for orthodontic screening. Upon radiographic examination of a pantomograph, a radiolucent lesion was noted on the furcation area of the mandibular left second molar. A 10mm periodontal pocket on the facial aspect was detected. The tooth was vital on endodontic examination. A partial volume CBCT scan was performed and showed a well-defined, corticated, round, radiolucent entity in the furcation area of the mandibular left second molar with lingual tilting of the roots. A diagnosis of buccal bifurcation cyst was made and the patient decided not to perform a biopsy and preferred a periodic follow up. After 6 months on clinical exam all tissues were within normal limits. On radiographic examination of a new partial volume CBCT scan the lesion had significantly decreased in size and there was evidence of bone deposition.

Conclusion: As the histopathologic features of the buccal bifurcation cysts are nonspecific, diagnosis of this entity has to be performed with its clinical and radiographic characteristics. Over time, the treatment for this condition have changed drastically, from tooth extraction and curettage to enucleation and preservation of the tooth. Lately a new and more conservative approach has been described. Only few cases have been reported where this cyst has resolved after periodontal probing or daily irrigation of the buccal pocket with saline, this new approach being described as "micro-marsupialization"

80. Quality of Life in Children With Unilateral Cleft Lip/Palate

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Objective: To evaluate quality of life in children with unilateral cleft lip and/or cleft palate.

Methods: This is a retrospective study design utilizing children and parent questionnaires regarding physical, emotional, social, and school functioning domains. The sample population consisted of children (and their parent) attending the University of Iowa Hospitals and Clinics Cleft Lip and Palate Clinic. Data were collected during their regular intake visits in the years 2016-2017. This study compared the perception of children to the perception of their parents with regards to Quality of Life (QoL). Paired-sample tests were used to examine differences in QoL between children and their parents (alpha=0.05).

Results: The study cohort consisted of 52 children and their parent (children mean age=7.8years; 58% males). Analyses indicated that the average scaled scores for physical functioning was significantly different between children (85.4) and parent (88.9), P=0.001. The average scaled scores for the emotional functioning as reported by children was 74.7 (compared to 79.4 reported by parent). The average scaled scores for the social functioning as reported by children was 81.7 (compared to 85.8 as reported by parent). The average scaled scores for the school functioning as reported by children was 78.2 (compared to 77.5 reported by parent). The total average scaled scores for all domains as reported by children was 80.2 (compared to 82.9 reported by parent).

Conclusions: Both children and parent reported similar QoL scores except for the physical functioning domain.

81. Image Properties of Graphene Oxide in Cone Beam Computed Tomography

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Objective: To evaluate the imaging properties of the graphene oxide in cone beam computed tomography.

Methods: Five different materials (graphene oxide, *gutta percha*, titanium, metal alloy and amalgam) were individually placed in the center of an acrylic phantom. Three images of each set (phantom + material) were acquired using a Picasso Trio unit (Vatech, Hwaseong, South Korea) set at 80 kVp, 3.7 mA, 0.2 voxel size and 12 x 8.5 cm field of view. Additionally, three images of a control group (sound phantom) were obtained. Eight ROIs were established in each image to evaluate the standard deviation of gray values in the ImageJ Software (U.S. National Institutes of Health). For the statistics, Kruskal Wallis and Student-Newman-Keuls post-test with a significance level of 5% were employed.

Results: The images of the control and the graphene oxide groups showed fewer artifacts (<0.05) than those obtained with the other materials, with no differences between them (p = 0.6682). The images acquired with gutta-percha and titanium did not show differences between them (p = 0.748) or between them and the images obtained with the metal alloy (p = 0.064 and p = 0.126, respectively). On the other hand, images acquired with amalgam showed more artifacts than those obtained with gutta-percha (p = 0.019) and with titanium (p = 0.044).

Conclusions: The graphene oxide produced fewer imaging artifacts than the other materials tested. Therefore, the authors recommend that more studies on graphene oxide be performed, allowing its clinical application in dentistry.

82. The Use of Virtual Reality Goggles on Patient Pain and Behavior in Pediatric Dentistry: A Pilot Study

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Objective: Virtual reality (VR) technology has recently experienced growth in its application to the healthcare fields[1]. It has been proposed that virtual reality and other forms of immersive audio-visual distraction can be used to decrease pain and anxiety during stressful procedures, such as dental work. The purpose of this pilot study was to evaluate the effectiveness of virtual reality audio-visual distraction goggles on pain and behavior scores in a population of 8-12 year old dental patients receiving routine dental care in an outpatient clinical setting.

Methods: Seven healthy, normally developed 8-12 year old pediatric patients were recruited at the University of Iowa College of Dentistry for this pilot study. Subjects were required to have a treatment plan of at least two quadrants of restorative dental work, along with no reported history of severe dental anxiety. A split-mouth design was utilized, in which one quadrant of work was completed with virtual reality goggle distraction, and the other quadrant completed at a different appointment without the goggles. The subjects rated pain using the Wong-Baker FACES Scale[5], and behavior was rated by an examiner using the Frankl Behavior Score[6].

Results: The average reported Faces Scale rating for pain with the VR goggles was 2.29±1.60, while without the goggles was 4.00±2.94 (p= 0.31). Frankl Behavior Scores for subjects with and without goggles were 4.00±0.00 and 3.71±0.76, respectively (p= 0.99). The results weren't shown to be statistically significant.

Conclusion: Virtual reality googles did not have a statistically significant effect in decreasing patient pain and behavior, in this pilot study. Several limitations were noted, including steep learning curve, limited available media, and large goggle size.

83. Pediatric Dentists' Satisfaction With Previous Associate Employment Agreements

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Objective: This study assessed levels of satisfaction or dissatisfaction of pediatric dentists' previous history of associate employment agreements. The main goal was to assess whether or not the pediatric dentist would recommend their previous employment opportunity to a colleague.

Methods: A web-based survey was administered to pediatric dentists from the AAPD active membership directory (n=6,583) in Fall 2018. Satisfaction of dentists who were previous associates was analyzed using a logistic regression to model using their most current associate experience by gender, practice location, presence or absence of children under 18 in the household, and dental school graduation year (*P*<.05).

Results: After adjusting for undeliverable surveys and incomplete responses, the final number of usable surveys was 414 (adjusted response rate=6.3%). Overall, 63.2% of respondents would recommend their previous associate employment to a colleague. Significantly fewer females would recommend their previous associate employment when compared to males (*P*=0.0042). No significant differences were noted by age or whether the dentist had children (*P*>0.05 in all instances). The top two attributes that led to either satisfaction or dissatisfaction in employment were, respectively: income (51.21% vs. 30.2%), and practice treatment philosophy (43.48% vs. 34.5%).

Conclusions: Despite a low response rate, data from this survey reveals that over two thirds of pediatric dentists who have been in an associate agreement would recommend their previous employment to a colleague. Satisfaction and dissatisfaction in associate agreements was attributed to a variety of reasons.

84. Pediatric Dentists' Opinions regarding Non-traditional Clinical Hours

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Objective: Pediatric dental practices in the United States have traditionally held operating hours corresponding to both the conventional American workday and school day. This may result in scheduling conflicts which could stand as barriers to children's optimal dental care. The objective of this study was to gain an understanding of pediatric dentists' experiences, perceptions and insights regarding non-traditional clinical hours.

Methods: A 14-question survey instrument related to clinical practice hours was designed and distributed to members of the American Academy of Pediatric Dentistry (AAPD) via email. Descriptive statistics were applied for practice and demographic information. Statistical analysis was performed using Chi-square or Fisher's exact tests.

Results: The survey was sent to 7142 members of the AAPD and returned by 642 individuals (response rate = 9.0%), 499 (77.8%) of whom self-identified as pediatric dentists. One hundred and twenty (60.6%) indicated that they did not appoint patients after 5pm and 127 (60.3%) did not see patients on Saturday. Respondents cited highest demand times between 3-5pm (67.1%) and lowest demand times between 10am-12pm (56.7%). There is evidence to suggest that practice locale (e.g. urban vs rural) and whether a practice is open on Saturday are not independent (Chi-square, $P < 0.05$). Additionally, low demand times are not independent of practice locale (Fisher's exact, $P < 0.05$).

Conclusion: The majority of respondents indicated that they adhere to traditional dental practice hours and do so for a variety of reasons, however, practice locale may influence practice hours and demand times.

85. Single Cell Transcriptome Analysis of Tooth Initiation

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Teeth are developed from the crosstalk of dental epithelial and mesenchymal tissues. Tooth development occurs in stages, and the process begins under the control of the oral epithelial tissue. The epithelial tissue of the dental placode instructs the development of the tooth by synthesizing signaling molecules including Shh, Wnt, Bmp and Fgf signals. These signaling pathways control the expression of specific transcription factors in the epithelium and mesenchyme. One of the earliest transcription factors to be expressed in the dental epithelium is Pitx2 (paired-like homeodomain transcription factor 2). We are interested in what initiates the program of the tooth development. To determine what gene regulatory network is required for tooth germ initiation, we profiled gene expression in the developing oral epithelium and mesenchyme during early stages of tooth development (E9.5, E10.5, E11.5 and E12.5). We used Fluorescence activated cell sorting (FACS) and Laser Microdissection (LMD) to isolate epithelial and mesenchymal cells from early embryonic stages of tooth development. After tissue isolation, we extracted RNA and performed RNA-seq using the SMARTSEQ-2 protocol.

86. Head Lice and Pediatric Dentistry

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Objective: To compare the attitudes, knowledge, and policies regarding patients with head lice between pediatric dentists' offices and community health centers. Additional goals were to determine dentists' training sources on head lice and how training affected practice policies.

Methods: A survey was emailed to 340 pediatric dentists (PDs) and general dentists in community health centers (GDs) in the states of Iowa, Missouri, and Kansas. Statistical analysis consisted of descriptive, bivariate, and logistic regression analyses (alpha=0.05).

Results: Response rate was 20% (27 GDs, 40 PDs) of which 26.9% reported having a policy pertaining to patients with head lice and 23.9% reported being familiar with the American Academy of Pediatrics (AAP) guidelines on head lice. Bivariate analysis revealed that compared to GDs, PDs were more likely to discuss head lice with the family (97.5% vs 81.5%, p=0.0353), be familiar with the AAP guidelines (35% vs 7.4%, p=0.0099), report receiving training on head lice (60% vs. 33.3%; p=0.0322), and feel comfortable identifying head lice (80% vs. 51.8%; p=0.0148). Furthermore, logistic regression analysis showed that PDs were more likely to proceed with dental treatment if suspecting a patient has an active head lice (OR=4.27; 95% CI: 1.19-84.59), practice in a rural setting (OR=7.79; 95% CI: 1.58-38.49), and not have hygienists discuss head lice with the family in their office (OR=10.53; 95% CI: 1.63-68.0).

Conclusion: Compared to PDs, GDs reported less training and were less familiar with AAP's guidelines on head lice, which may affect their comfort in identifying, treating, and discussing head lice with families.

87. Explaining Member Intention to Complete Dental Healthy Behaviors — An Examination of Iowa's Medicaid Healthy Behaviors Program

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Objective: In July 2017, the Dental Wellness Plan, Iowa's Medicaid dental benefits program, implemented a Healthy Behaviors (HBs) Program wherein members must complete two HBs annually- a dental visit for check-up/cleaning, and an online oral self-assessment. Failure to complete both behaviors results in the payment of $3/month premium for the succeeding year. Our study objective is to examine factors associated with members' intention to complete the dental visit component of Iowa's Medicaid HBs program.

Methods: DWP members were surveyed in March 2018 (N=18,000). Outcome is member intention to complete dental visit i.e., response 'Yes' to either question: 'Since July 2017, have you seen a dentist for check-up/cleaning?', or 'Do you plan to see a dentist for check-up/cleaning before July 2018?'. Andersen Model of Healthcare Utilization was used as a framework for covariates selection.

Results: Adjusted response rate was 23.8% (N=3748). 83% of survey participants reported intention to complete dental visit. Bivariate analyses (Chi-square tests) found that intention to complete dental visit was significantly associated (p<0.05) with: predisposing characteristics- lower age, female gender, employment, >high school degree, excellent/ very good oral health, regular dental visits, some knowledge of HBs program, and knowledge of having dental insurance coverage; enabling characteristics- presence of regular dentist, perceived ease in getting dental check-up, and perceived ability to pay $3/ month premium; and need characteristics- perceived dental care need, pain in mouth during past 6 months, and loss of fewer teeth.

Conclusions: Multiple factors were found to be associated with member intention to complete a dental healthy behavior. Multivariable regression modeling will be performed to test bivariate associations.

88. Mesoporous Silica Nanoparticles With Sustained Release of Proanthocyanidins Enhancing Dentin-Resin Interactions for Restorative Dentistry

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Secondary caries with degenerative dentin-resin interactions is a major problem requiring replacement of adhesive resin and restoration of teeth. The development of durable, long lasting novel biomaterials with the ability to enhance dentin-resin interactions is essential for restorative dentistry. Dentin is a calcified tissue consisting of micron sized tubules spanning from the pulp to the dentin-enamel junction, as well as the intra-tubular, and peri-tubular dentin. The penetration of resin into the tubules of dentin is critical. The application of nanoparticle embedded resin will facilitate better penetration into the tubular structures and hence facilitate strong dentin-resin interactions. Proanthocyanidins (PACs) are oligo and polymeric tannins, which are known to preserve the dentin-adhesive interface and have the potential to be applied to restorative therapy. In this study, worm hole type mesoporous silica nanoparticles (MSN) were synthesized and functionalized with aminopropyltriethoxysilane (APTES). PACs were encapsulated into MSN nanoparticles at different weight ratios of 3:1, 3:10, 3:65, 3:300 and 3:500. The encapsulation efficiency of PACs was calculated using a butanol-HCl assay where the MSN:PAC 3:65 combination showed the highest encapsulation efficiency of 52%. Drug release kinetics, carried out in 1x phosphate buffered saline at pH-7.4 for 30 days, showed sustained release of PACs from all formulations. The MSN:PAC 3:65 combination showed the highest drug release while MSN:PAC 3:5 showed the least drug release. The drug release kinetics showed that all the formulations are in good agreement with Higuchi kinetics with R^2 values >0.95, signifying sustained release of PACs from nanoparticles. The sustained release of PACs from MSN:PAC 3:65 for longer periods with highest encapsulation efficiency will provide an advantage soluble PAC loaded dental resins by having prolonged restorative effect on the dentin-resin interactions.

89. Efficacy of Gutta Percha Removal and Time Required for Retreatment With XP-3D Shaper and XP-3D Finisher, ProTaper Retreatment Files, and Gates Glidden Systems

Brittany G. Kawas[1], *B. Cavalcanti*[1], M.S. Campos[1], A. Williamson[1], X. Xie[1], F.B. Teixeira[1]

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The purpose of this study was to assess, by computerized micro-CT analysis, whether three different retreatment systems (XP-Endo Shaper + XP-Endo Finisher, ProTaper Retreatment Files, and Gates Glidden + Hedstrom files) are able to adequately clean gutta-percha and debris from the root canal, while also comparing the amount of time required for each system. Twelve single-rooted mandibular premolars with closed apices were instrumented up to a 25.04 Vortex Blue Rotary File and obturated using continuous wave warm vertical compaction with gutta-percha and BC sealer. Teeth were randomly divided into three groups: XP-Endo Shaper + Finisher, ProTaper Retreatment Files, and Gates Glidden + Hedstrom files. Retreatments were carried out under the manufacturer's directions and timed. All the specimens were scanned after obturation and after retreatment using SkyScan 1272 X-ray microtomography (Bruker microCT, Kontich, Belgium). The retreatments were analyzed using NRecon v.1.6.9 software. One-way ANOVA test, Kruskal-Wallis rank sum test, and a power analysis were performed. The results demonstrated no difference among the tested groups regarding the amount of gutta-percha removed and amount of time required to complete retreatment between XP-Endo Shaper + Finisher, ProTaper Retreatment Files, and Gates Glidden + Hedstrom files.

90. Efficacy of an Alternative Brand Device for Warm-Vertical Compaction

Jay F. Leer[1], *A.E. Williamson*[1], F. Qian[1], D.R. Drake[1]

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Objective: This study compared the efficacy of a heat-activated downpack device manufactured by an unknown company in China versus a retail company (the control) in placing a master gutta-percha cone in the apical third of a premolar.

Methods: Ninety-six mandibular premolars with a straight, single canal were divided into two groups. After the teeth were prepared and mounted, gutta-percha cones were inserted with the root canal sealer. The cones were first seared off at the occlusal level, and a downpack tip that loosely binds at five millimeters short of the working length was inserted. Time was measured from the searing of the cone to the withdrawal of the tip from the canal. The canal space was also inspected to determine if the excess gutta-percha was removed with the tip. The Wilcoxon rank-sum and Shapiro-Wilks tests were used to evaluate the time difference. A chi-square test was used to measure the statistical significance of the two instruments' ability to remove the excess gutta-percha.

Results: The control device took significantly less time to sear the master gutta-percha cone than the alternative device (P<.05). The control device was significantly more efficient in removing the excess gutta-percha (79.2%) than the alternative device (12.5%).

Conclusions: Within the limitations of this study, the retail downpack device was significantly more efficient than the alternative device in searing a master gutta-percha cone in the apical third and removing the excess gutta-percha from the canal walls.

91. Predictors for Having a Dentist Among Older Adults in Iowa

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Oral health plays an important role in the general well-being of older adults, yet older adults experience unique barriers to dental care compared to other age groups. Almost two-thirds of older adults are dentally uninsured — a reflection of the exclusion of dental benefits from Medicare. The aim of this study was to investigate potential predictors of having a dentist among older adults receiving services from the Iowa Department on Aging (IDA). To receive IDA services, older adults age 60+ or their caregivers are required to answer a questionnaire that includes questions about demographics, activities of daily living (ADL), and instrumental activities of daily living (IADL). In 2017, the IDA started asking the question: "Do you have a dentist?". Data from questionnaires completed between March-Dec 2017 were used to generate multivariable logistic regression models that identified predictors of having a dentist. Explanatory variables eligible for inclusion in the models were age, sex, race, ethnicity, income, agency, urbanicity, ADLs (bathing, dressing, eating, toileting, transferring, walking), IADLs (light housework, heavy housework, preparing meals, taking medicines, managing money, using the phone, shopping, transportation), having tooth or mouth problems, and having dental insurance.

Among the 1,927 participants who were age 65+ and answered the question about having a dentist, only 891 (46.2%) answered positively. The final model (c= 0.637) identified six strongest predictors as: having dental insurance (p<0.001), living in the northern IDA regions (p<0.001), being female (p<0.001), not having tooth or mouth problems (p=0.014), doing light housework without help (p=0.020), and getting transportation without help (p=0.026). These results align with known insurance-related barriers and identify certain IADLs that might influence older adults' ability to access care. The finding that individuals with oral health problems were less likely to report having a dentist underscores the need to reduce barriers to care.

92. Comparison of Torque Angles in Wide and Narrow Edgewise Brackets

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Objective: Compare torque angles in wide [upper] (WD) and narrow [lower] (N) central incisor brackets in non-torqued slots with 18X25 mil arch-wires: stainless steel (SS), nickel-titanium (NT), and tungsten-molybdenum (TMA). Hypotheses: (1) that a torque angle with a force similar to published recommendations acted similarly in WD and N brackets, and (2) that there is no difference in torque angles among three arch-wire alloys in either WD or N brackets.

Methods: A machine recorded torque angles (in degrees) for central incisors (n=5/per group). The force at the machine wheel was 67 grams and at the wire was 43.25 N-mm. One-way ANOVA with post-hoc Tukey's HSD was conducted to test for the differences in torque angles among the three types of arch-wire alloys in WD and N brackets, and a paired-sample t-test was used to detect differences between WD and N brackets within each arch-wire alloy (alpha = 0.05).

Results: Both hypotheses were rejected. WD had significantly lower torque angles than N for all alloys (p<0.01 in each instance). In N brackets, NT resulted in a significantly higher torque angle than SS and TMA (38.0±1.2 vs. 25.8±2.2 vs.33.9±2.2; p<0.01; respectively), while in WD brackets, SS resulted in a significantly lower torque angle than the other two arch-wire alloys (21.4±1.1 for SS vs. 26.0±1.7 for TMA or 26.0±0.7 for NT; p<0.01) and no difference was found between TMA and NT.

Conclusions: (1) Differences occurred in torque angles between WD and N brackets; and among the three arch-wire alloys. (2) The force rotated wires to a higher angle than desired for incisors. (3) Orthodontic biomechanics must be explored by scientific method.

93. Propolis Reduces the Stemness of Head and Neck Squamous Cell Carcinoma

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Objective: Cancer stem cells (CSC) constitute a small sub-population of tumor cells that function as drivers of tumor progression and resistance in head and neck squamous cell carcinoma (HNSCC). Propolis, a natural compound produced by bees, has shown anti-angiogenic and anti-tumor properties in several types of cancer. Here, we tested the hypothesis that propolis ablates head and neck cancer stem cells.

Methods: HNSCC cell lines (UM-SCC-17B and UM-SCC-74A) and primary human dermal microvascular endothelial cells (HDMEC) were treated with 0-50 μg/ml green, brown or red Brazilian propolis for 24-72 hours. Cell viability was evaluated by Sulfohrodamine B assay. Western blots evaluated expression of CSC markers (*i.e.* ALDH, CD44, Oct-4, Bmi-1) and flow cytometry was performed to determine the impact of propolis in the fraction of CSC, defined as $ALDH^{high}CD44^{high}$ cells.

Results: Propolis significantly reduced cell viability of HNSCC and HDMEC cells. Notably, red propolis caused a significant reduction in orosphere number and downregulated the expression of stem cell markers.

Conclusion: Collectively, our data demonstrate an anti-CSC effect of propolis, and suggest that propolis (*i.e.* red propolis) might be beneficial for patients with head and neck cancer.

94. Visualization and Assessment of the Relationship Between the Inferior Alveolar Canal and the Mandibular Third Molars With Three Different Monitors

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The inferior alveolar canal (IAC) is a familiar landmark for dentists. Clear visualization of the IAC and its relationship with developing or impacted mandibular third molars is especially important. Cone beam computed tomography (CBCT) has improved the ability for more accurate assessment of the IAC.

Objective: The aim is to determine if there is a difference in the ability to appropriately assess the third molar-canal relationship between three different monitor types.

Methods: 105 scans were randomized and evaluated by two calibrated and masked evaluators. Evaluation was performed on three different monitors, BARCO 3MP medical grade monitor, a prototype BARCO 2MP monitor, and DELL ultrasharp monitor. Evaluations were completed in a dimly lit area. The luminance and ambient light were measured using a light meter. All three monitors were placed in same position for the evaluators and were adjusted such that the luminance was the same. The gold standard was established by two board certified oral and maxillofacial radiologists and one oral and maxillofacial radiology resident who assessed the datasets after the evaluation was completed and reaching consensus on the location of the IAC.

Results: The medical 3MP monitor demonstrated the best interrater reliability with a percent agreement of 87% with a Kappa value of 0.83. Accuracy was statistically significant with the medical 3MP over the consumer display with an average increase in accuracy of 10.1%. A statistically significant higher accuracy (7.2%) was also obtained for the medical 3MP in comparison with the medical 2MP by one observer.

Conclusions: This study found that location of the IAC can be well visualized and with a higher degree of accuracy on Medical grade display (3MP) monitors compared to consumer displays. The 2MP prototype medical monitor showed higher degree of accuracy compared with consumer grade monitor though the results were not statistically significant.

95. A Case-Control Study to Assess the Cost-Effectiveness of the Stepwise Caries Removal Procedure (SWP)

Paula Ortega-Verdugo[1], *J.J. Warren*[1], J.L. Kolker[1], D. Shane[1]

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Objective: The management of deep carious lesions (DCL) traditionally has involved removal of all decayed tissue before a filling is placed. However, the benefits of traditional caries removal (TCR) have been questioned because of the possible adverse effects of removing all decay including the need for additional costly treatments. The SWP is a less invasive alternative to TCR, and may reduce costs by avoiding the need for additional treatment. However, studies reporting cost-effectiveness (CE) of SWP and TCR are limited and have only used simulated economic models and not actual patient data. This study assessed the CE of these two strategies.

Methods: 200 patients that had a DCL treated with SWP between 2004- 2016 at the University of Iowa College of Dentistry were matched to 200 patients who had TCR (controls) on patient's age, gender, type of provider, and dental insurance and were followed for 5 years. A CE analysis was performed by comparing cost and success outcomes between the SWP and TCR, adjusting for treatment fees and for inflation rates. Our primary outcome was tooth vitality, defined as the time the tooth remained vital (not having an endodontic /extraction treatment and assuming the absence of irreversible pulpitis symptoms) within the 5-year period. Secondary outcome was tooth retention (not having extraction in 5 years).

Results: CE ratio showed that SWP results in cost savings of 64% on average compared to TCR. From an effectiveness standpoint, there was no difference in tooth vitality between TCR and SWP (85% vs. 83.5% respectively) during 5 years. The proportion of tooth retention was slightly higher in TCR (95%) than SWP (91%), however, during the follow-up period.

Conclusions: Our findings showed that SWP is nearly as effective as TCR on keeping tooth vitality with significantly lower long-term costs compared to TCR.

96. Comprehensive Identification of Micro-peptides Encoding Long Noncoding RNAs in Human Tissues
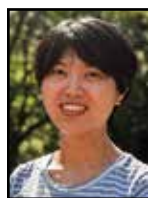
Fan Shao[1], M. Li[1], M.E. Sweat[1], Q. Qian[1], Y. Guo[1], *B.A. Amendt*[1], *L. Yang*[1], *H. Cao*[1]

[1]University of Iowa, Iowa City, IA

Many poorly characterized long noncoding RNAs (lncRNA) are expressed in human pancreas. Recently, a few lncRNAs have been found encode very small open reading frame, so-called micropeptides. By regulating larger protein complex, these micropeptides have been shown to have important roles in fundamental biological processes such as muscle performance, mTORC1 activation and cell movement. To determine if any micropeptide play critical role for pancreas functions, we have taken a bioinformatics approach to comprehensively analyze protein coding potential for lncRNAs expressed in human pancreas. We found more than 30 lncRNAs that are likely to encode micropeptides. We have verified one conserved micropeptide, which we named Beta cell Glucose Regulated Micropeptide 1(BGRM1). We found BGRM1 regulate calcium homoeostasis and insulin secretion in beta cell. We have also performed mass spec to identify its binding proteins. Our result shows that some of lncRNA expressed in human pancreas might actually be translated as micropeptides and they play important roles for pancreas functions. We have also used the same pipeline to analyze lncRNA expressed in other

organs. These results provide foundations for future comprehensive analysis of micropeptides functions.

97. Progenitor Cells Homing via MSC Exosomes for Temporomandibular Cartilage Repair

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Objectives: Progenitor cell-based therapy is one of the novel strategies to repair temporomandibular joint (TMJ) disorder. However, the limited migratory capacity of progenitor cells may limit their therapeutic effect. The exosomes are the cell-derived vesicles expressed from various eukaryotic cells, which contain cargo including proteins, miRNA, mRNA, enzymes, etc. Those exosomes play a key role in intracellular signaling via the transfer of functionally relevant biomolecules, and mesenchymal stem cell-derived exosomes (MSC-Exo) have been found to have therapeutic potential. The purpose of this study was to identify the characteristics of MSC-Exo and their chemotactic effect of TMJ progenitor cells.

Methods: MSCs were collected from male bovine subchondral bone and cultured in the medium with 10% exosome-depleted fetal bovine serum. The medium was collected after 48 hours, and MSC-Exo were isolated by a sequential centrifugation and re-suspended with various concentrations (0, X4, X20, and X100). Then, MSC-Exo were characterized by transmission electron microscopy and zeta potential, intensity, size and quantity measurement. Bovine condyle explants were injured by needle scratches, and cells migrating toward the injury site were observed using confocal microscopy and isolated for migration assay. Migration assay was conducted for 24 hours using 0.8 µm-pore Transwell® plate.

Results: The exosome concentration in MSC-conditioned medium was 6.26×10^7/ml, and isolated vesicle size and zeta potential were between 40-150 nm and -26.1 mV respectively. Needle scratches on TMJ cartilage induced progenitor cell migration toward injury site. Migration assay results showed that the number of migrated cells after 24 hours was 370 times greater in the MSC-Exo (X100) group compared to control (*p<0.001).

Conclusion: Overall, we successfully isolated and characterized MSC-derived exosomes and identified that MSC-Exo enhanced TMJ progenitor cell migration, which is eventually beneficial for TMJ cartilage repair. In the future, active components of exosomes stimulating chondrogenesis will be identified.

98. Identification of New Targets of miR-24-3p in Mouse Odontogenic Cells

Dan Su[1], F. Shao[1], S.L. Eliason[1], *H. Cao*[1], *B.A. Amendt*[1]

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Mature *miR-24* is a 22-nucleotide microRNA which is abundant and conserved through species. In recent years, *miR-24* has an emerging role in regulating tumorigenesis and cell differentiation. Our lab previously reported that *miR-24* was significantly highly expressed in the incisor epithelium and mesenchyme of P0 mice, indicating its important role in regulating tooth development. In this study, *miR-24* was selectively inhibited by using a Plasmid based MicroRNA Inhibitor System (PMIS) for identifying its new targets in mouse odontoblast cell line (MDPC) and ameloblast-like cell line (LS8). In addition, the targets of *miR-24-3p* have been predicted by four prediction tools and top hits from the prediction are found to be upregulated at both transcriptional and translational level in PMIS-*miR-24* stable cell lines, including genes involved in craniofacial development. The top candidates Plod2 and Whsc1, which are also genes found to be involved in craniofacial development, have been confirmed as direct target of *miR-24-3p* by luciferase assay results. All these results indicate that *miR-24-3p* may have a role in regulating craniofacial development through inhibiting the transcription of the related gene. Thus, to further investigate its role, we are generating *miR-24-3p* inhibition mouse strain (PMIS-miR-24) via our PMIS system. The future direction will be identifying craniofacial phenotypes of PMIS-miR-24 inhibition mouse and study the underlying mechanisms.

99. Access to Dental Care: The Role of the Oral Health Workforce

Jennifer M.C. Sukalski[1], *J.C. Reynolds*[1]

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Objective: Oral health is an essential component of overall health and quality of life. Improving oral health requires the ability to access dental care, and access is dependent on an adequate dental workforce. Authors examined trends in dental workforce composition, approaches to future workforce development, and current dental safety net capacity and how these topics influence access to dental care.

Methods: In consultation with the Association of State and Territorial Dental Directors (ASTDD), authors completed a comprehensive review of published peer-review and grey literature, and publicly available data. Findings were used to update an

existing ASTDD Best Practice Approach Report, with the goal to identify up-to-date, innovative strategies to improve access to care through workforce development.

Results: Workforce-related factors that influence access include workforce size and composition, provider scope of practice and education, and dental safety net capacity. For example, declining numbers of dental practices will limit access for rural residents. Educational costs and experiences may influence provider decisions about caring for underserved populations. Examples of action steps include expansion of programs that incentivize providers to practice in underserved areas, enhanced use of extramural and outreach programs in dental curricula, and increasing the capacity of the dental safety net through increased efficiency or expanded outreach efforts.

Conclusions: Numerous factors impact the ability of the dental workforce to meet population demand for care. Our findings provide potential action steps that could address workforce-related factors affecting access to dental care.

100. Gaps and Voids in Root-End Filling Materials: A Micro-CT Analysis

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Introduction: This study was conducted to evaluate the presence and volume of gaps and voids in three different root-end filling materials: 1) BC Putty: Endosequence BC RRM-Fast Set Putty (BC RRM-FS; Brasseler USA, Savannah, GA); 2) PR-MTA: ProRoot MTA (PRM; Dentsply Tulsa Dental, Tulsa, OK) and 3) BIO: Biodentine (Biodentine Active Biosilicate Technology Scientific File, Septodont, Paris, France) using microcomputed tomography (micro-CT) analysis.

Methods: The mesial roots of thirty-three extracted human mandibular molars were instrumented with the WaveOne Gold file (Dentsply Maillefer, Ballaigues, Switzerland) and obturated with a gutta-percha single cone. The apical 3 mm of the root tip was resected, and root-end preparation was performed with an ultrasonic tip (Kis-1D, Obtura Spartan, Fenton, MO). Root end cavities were filled with the experimental filling materials. The samples were scanned by micro-CT (Skyscan 1272, Bruker, Belgium). The three-dimensional images were reconstructed (NRecon, Bruker, Belgium) and the volume of the gaps (between the dentinal wall and the root-end filling materials) and voids (within the filling material) were assessed and the percentage volume of the gaps (VG%) and voids (VV%) were calculated (Ct-An, Bruker, Belgium). Data were analyzed using the Student T-test (*P*<.05)

Results: The mean VG values for the BC Putty, PR-MTA and BIO groups were respectively 0.187%, 0.038% 0.721%. Mean values for VV were 0.059%, 0.035% and 0.029% also respectively for BC Putty, PR-MTA and BIO. No statistical difference was observed among the materials for voids. A statistical difference was found between MTA and Biodentine (*P*<.05) regarding the gaps between materials and the cavity.

Conclusion: Biodentine had a greater gap volume percentage than MTA when observed for retro-filling in micro-CT analysis. All materials presented the same percentage of voids within their structure.

101. Micro-Computed Tomographic Evaluation of Obturation Quality: Analysis of Methodology

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Objective: The aim of this study was to evaluate two micro-computed tomography analysis methods for determining the quality of the root canal filling of three different obturation techniques.

Methods: Twelve mesial roots of mandibular first molars were used and divided into three groups (lateral compaction (LC), warm vertical condensation (WVC), and single cone (SC) using BC sealer). Both mesial canals (buccal and lingual) were instrumented to the proper length using Brasseler EndoSequence to size 35/.04. The prepared root canals were then obturated using LC, WVC, and SC techniques with BC sealer according to their assigned groups. All the specimens were scanned after instrumentation and after obturation using SkyScan 1272 X-ray microtomography (Bruker microCT, Kontich, Belgium) at a resolution of 21.9 μm. Image analysis was attempted using NRecon v.1.6.9 software using volume rendering with scalar fields and CT Analyser (CTAn) v.1.16.4.1 using 3D volume analysis to evaluate the volume of empty canal space in each sample.

Results: Analysis of empty canal volume with NRecon presented several challenges, including difficulty standardizing the region of interest for volume analysis before and after preparation, isolating empty canal space in the unprepared canals, and computer processing delays/errors due to extensive memory requirements. Analysis with CTAn also presented challenges, including imprecise selection of region of interest and difficulty following curved canal anatomy. No statistical analysis was completed.

Conclusion: Under the limitations of this study, it is concluded that micro CT analysis of obturation quality is highly technique sensitive and susceptible to data manipulation or misrepresentation, and studies should be carefully evaluated for clinical accuracy.

102. Utilization of Mini-Screw Supported RME Vs. Traditional RME to More Successfully Achieve a Midpalatal Sutural Split in Adolescent Patients

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Objective: Treating adolescent maxillary constriction often includes a traditional RME appliance, with the aim of creating a split of the midpalatal sutural (MPS). However, maxillary skeletal expansion becomes more difficult with age due to increasing facial, and mid-palatal, skeletal resistance. An emerging treatment option with the hopes of overcoming this skeletal resistance is a mini-screw supported RME appliance. The purpose of this study is to evaluate the age and maturation at which a successful split of the maxillary MPS can be achieved, and whether or not this can be improved with the utilization of a mini-screw supported RME appliance.

Methods: In this retrospective study, N=96 (n=43 M, n=53 F) consecutively treated subjects exhibiting maxillary skeletal constriction underwent traditional RME treatment and N=13 (n=7 M, n=6 F) underwent RME treatment utilizing mini-screws. Subjects were also classified into either pre-pubertal or post-pubertal groups based on maturation. Evidence of a MPS split was confirmed by the development of a diastema between upper central incisors and using a maxillary occlusal radiograph.

Results: Average age of pre-pubertal and post-pubertal subjects was 11.5 years (n=28) and 15.3 years (n=70) respectively. A MPS split occurred with traditional RME for 96% of the pre-pubertal group compared with 61% of the post-pubertal group. There was also a significantly strong negative correlation between age and percent ability to get a MPS split with traditional RME. In contrast, average age of mini-screw RME subjects was 17 years (n=13), all were classified as post-puberty, and a MPS split occurred 100% of the time.

Conclusion: Utilization of mini-screw supported RME is a good option for clinicians when treating post-pubertal adolescent patients. However, MPS separation is highly likely to occur in pre-pubertal patients treated with traditional RME. As a result, patient age and maturation should be taken into account when deciding between traditional or mini-screw supported RME treatment.

103. Antimicrobial Activity of Silver Ions and Nanoparticles — A Comparative Study

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The antimicrobial properties of silver-containing compounds, including silver ions (Ag^+) and silver nanoparticles (AgNPs) are well established. However, it is worth noting that their mechanisms of action are different, with Ag^+ directly interacting with thiol groups in enzymes and proteins while AgNPs damage the cell membranes and possibly form free radicals. Meanwhile, few studies have been aimed at comparing the antimicrobial activity of Ag^+ and AgNPs using the same protocol.

Objective: To compare the antimicrobial activity of Ag^+ produced by electrolysis to that of AgNPs against *S. aureus*, using a broth microdilution method.

Methods: Three Ag^+ solutions with increasing concentrations from 6 to 8 ppm (1 ppm increments), were produced by electrolysis of silver metal. Final Ag^+ concentrations were measured using an ion selective electrode (ISE). Based on previous studies, three AgNPs solutions with concentrations ranging from 160 to 200 ppm, in 20 ppm increments, were prepared by a chemical reduction method. Nanoparticle morphology and concentration were investigated by transmission electron microscopy (TEM) and ISE after digestion with H_2O_2. The minimal inhibitory concentration (MIC) was measured by a broth microdilution method, with broth only as a negative control. Bacterial growth curves up to 36h were obtained from the optical density (OD) at 600 nm. Experiments were conducted in triplicate.

Results: TEM revealed spherical AgNPs with a mean diameter of 12.5±2.7nm. The MIC at 36h was 8±0.00 ppm for Ag^+ compared to 200±14 ppm for AgNPs ($p<0.05$). The bacterial growth (lag phase) was extended from 6h to 22h with Ag 6 ppm, while a concentration of AgNPs of 180 ppm was necessary to produce the same inhibitory effect.

Conclusion: Ag^+ generated from the electrolytic method exhibited significantly higher antimicrobial activity and antimicrobial efficacy than silver nanoparticles, with a MIC 25 times lower than that of AgNPs.

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