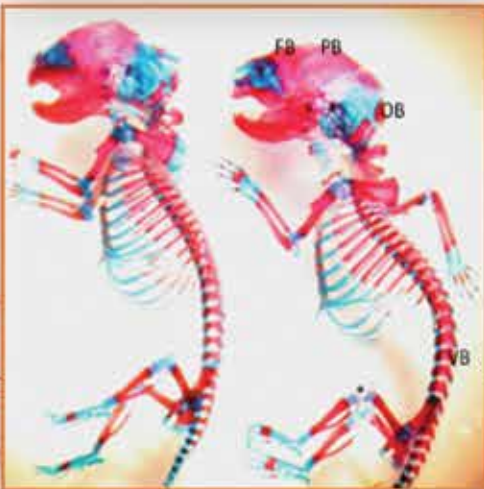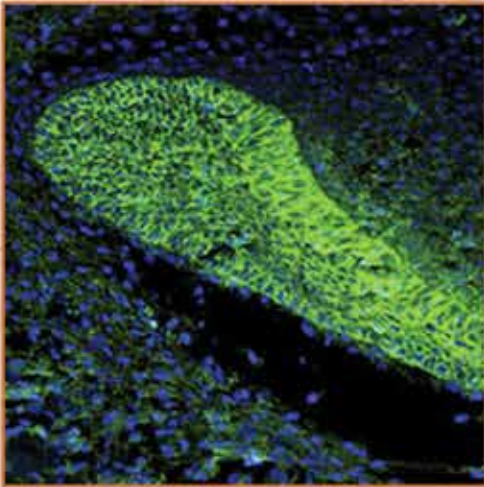# 2017

Iowa Section
of the
American Association
for **Dental Research**

64th Annual Meeting

The
University
of Iowa

College of Dentistry
& Dental Clinics

Our Keynote Speaker

Dr. Deborah Kacmarynski joined the Department of Otolaryngology-Head and Neck Surgery in July 2007 as fellow and August 2009 as faculty. She is a native of Denver, Iowa and attended the University of Iowa in Iowa City for her undergraduate biomedical engineering degree. Next, she worked as an engineer at 3M Company in St. Paul before changing careers to medicine. She then earned M.D. and M.S. degrees at the University of Minnesota while completing residency in Otolaryngology-Head and Neck Surgery at the University of Minnesota-Twin Cities. Following residency, she pursued fellowship training in Pediatric Otolaryngology at the University of Iowa, spending a second year in cleft and craniofacial surgery with Dr. John Canady, then President of the American Society of Plastic Surgery. After Dr. Canady's departure from medicine in 2011, Dr. Kacmarynski took over the cleft and craniofacial team and has focused on this aspect of care since. In 2015, she received an endowed professorship, the Paul N. Johnson Associate Professor of Craniofacial Abnormalities, a generous gift from Norm and Barb Johnson to honor his father who had cleft and lip palate. She helps patients with craniofacial abnormalities through clinical care and research.

As a member of the University of Iowa faculty, Dr. Kacmarynski's pediatric otolaryngology practice has a dominant focus in the areas of cleft and craniofacial surgery, including primary cleft lip repairs, primary and speech palate repairs, final cleft rhinoplasty and cleft lip revisions. She also partners with pediatric neurosurgery to perform craniosynostosis repairs and other craniofacial surgeries. She is the leader and co-director of the Iowa Cleft and Craniofacial Team that collaborates with faculty researchers throughout the University of Iowa and within the College of Dentistry.

Keynote Address:

Oral Clefting, Opportunities for the Next Score

Deborah S. Kacmarynski MD, MS
Paul N. Johnson Associate Professor
in Craniofacial Abnormalities
Department of Orolaryngology -
Head & Neck Surgery
University of Iowa Hospitals & Clinics

Dental research images for the cover were provided by Dr. Veerasathpurush Allareddy, Dr. Gustavo Avila-Ortiz, Dr. Zachary Goettsche, Steven Eliason, and Maggie Hogan.

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Preparing Dental Students for an Evidence-Based Dentistry Practice

Informing clinical judgement with the integration of scientific knowledge, patient preferences and clinician experiences within existing environments defines evidence-based practice. Science – the expression of research – informs the clinical decision making process, while clinical questions drive the evolution of science.

The University of Iowa's College of Dentistry curriculum prepares predoctoral students to practice evidence-based dentistry (EBD) using a 5-Step Process (i.e., Ask, Acquire, Appraise, Apply, Assess). Students are encouraged to identify knowledge limitations and seek high level evidence addressing their knowledge deficits.

> *"I have implemented EBD into my clinical treatment planning, and it has been a very positive experience. Evidence-based dentistry has helped me provide the best care for my patients, and confidently propose and support treatments."*

Students are provided the fundamental knowledge necessary to identify and read valid science sources, including research manuscripts, critical summaries and practice guidelines. Interpreting science is a process. Therefore, dental students are provided with opportunities to critically appraise science, to enable their appraisal skills to mature. Finally, they integrate scientific evidence, patient values and individual characteristics with their own experiences during the clinical decision-making process in student clinics. Iowa's EBD curricular outcome is a graduate competent to practice EBD at the level of an independently practicing (or autonomous) general dentist.

The Iowa Section of the American Association for Dental Research's (AADR) Annual Meeting provides an opportunity for dental students to be exposed to cutting edge research, including the realities of the research process, and to link science to patient care experiences. Similarly, the meeting is an opportunity for students to demonstrate the integration of science in patient care – to share with researchers the use of their scientific findings – which might include the real world limitations of science.

The Michael W. Finkelstein Evidence-Based Dentistry Competition was introduced in 2016 to enable students to showcase their EBD skills. The award was named in honor of Dr. Finkelstein, a highly respected education leader, who along with former College of Dentistry faculty, Dr. Lynn Johnson, used problem-based learning to introduce students to the dental literature – the foundation for the College's EBD program. Two third-year dental students or teams are selected from each of four fall clerkships (i.e., Operative, Pedodontics, Endodontics, Periodontics) based on the EBD component of their clerkship case presentation. During their clerkships, students present a patient case from the rotation to their faculty and student peers. Students are expected to utilize scientific evidence to address etiology, diagnosis, treatment, or outcome questions. Selected students refine their clerkship presentation for the Iowa Section's AADR meeting and are judged on their adherence to the 5-Step EBD Process, including integration of science with patient care.

Caitlin Miller (Class of 2017) represented the Periodontics clerkship and received first place in the 2016 competition for her presentation on "Alveolar Ridge Augmentation." When asked about her EBD training, Caitlin responded, "I have implemented EBD into my clinical treatment planning, and it has been a very positive experience. Evidence-based dentistry has helped me provide the best care for my patients, and confidently propose and support treatments. Evidence-based dentistry has also helped me better educate my patients, and I find they appreciate that the recommendations are based upon significant results. My classmates and I plan to apply EBD when in practice, especially with new products and procedures, as it will keep us current. Practicing with EBD will ensure we continue to grow as dentists outside the walls of the school."

Drs. Teresa Marshall, Department of Preventive Dentistry, and Cheryl Straub-Morarend, Department of Family Dentistry, are very proud of Iowa's EBD program. They designed and implemented an EBD curriculum that crosses years and disciplines to provide continuing education courses for dental professionals, and research evidence-based practice knowledge, perceptions, and behavior. They have shared their efforts with peers through national presentations and peer-reviewed publications.

For their efforts, Drs. Marshall and Straub-Morarend were honored as evidence-based leaders by the American Dental Association (ADA) and the AADR in 2016. This was the first time that the ADA and AADR recognized a team (Marshall and Straub-Morarend) with the Evidence-Based Dentistry Faculty and Practice Award.

Photo (Left to right): Dr. Cheryl Straub-Morarend, Caitlin Miller (Class of 2017) and Dr. Teresa Marshall

Dr. Peter Damiano, Department of Preventive & Community Dentistry and director of the UI Public Policy Center (PCC), entered research by accident.

An Iowa dental student in the 1980s, Damiano did an internship working in former U.S. Senator Tom Harkin's office researching some Medicare policy changes. "The research and report process," he says, "showed me the importance of providing research-based data to inform and improve the public policy decision-making process."

After graduation, he spent two years with the Indian Health Service. "It was quite a clinical and cultural experience. It brought home the importance of treating both individuals and populations to improve health."

From 1988-1990, as a dental public health graduate student and a Robert Wood Johnson Dental Health Services Research Scholar, Dr. Damiano learned about research methods and issues concerning access to care, quality of care, and cost of care at the health systems level. He also realized the value of non-partisan research on sensitive issues.

In 1990 he was hired jointly by former Dean James McLeran as a faculty in the Department of Preventive & Community Dentistry and Dave Forkenbrock in the new Public Policy Center (PPC). During this time, Damiano initiated the health policy research program at the PCC to conduct health services/policy research on nationally significant health policy topics.

In 2007, after becoming PCC director, he added several research programs to the Center: environmental policy; social and education policy; politics and policy; and the Iowa Social Science Research Center to support grant applications and data collection for campus researchers.

"One of our primary missions at the UI, including the College of Dentistry and Public Policy Center," he says, "is creating new knowledge through research." Noting the College of Dentistry's ties to research, Damiano adds, "It can be challenging during tight budget times, but it is critically important that the College of Dentistry maintain its status as one of the top dental schools in the world. The College has done a good job educating its dental students, with faculty who are on the cutting edge of new science with important clinical applications."

In 2016, the PCC was the highest funded center at the UI with $31 million in external funding. Working with faculty and staff from almost every unit, the center produces data that informs policy makers and the public about important societal challenges and facilitates campus-wide collaborations on research projects.

The PPC is not an advocacy center, Damiano stresses. Its non-partiality helps with the credibility of their research for policymakers and the public. For instance, PCC research conducted on the former IowaCare program determined that the program's biggest gap was oral health. As a result, Iowa's Medicaid program was expanded to cover dental care services to low income adults.

"The most difficult problems we face require effectively studying multiple perspectives."

A community engagement program was created under Damiano's directorship to disseminate research information to the public and to policy makers through speakers, symposia and policy briefs.

"The most difficult problems we face require effectively studying multiple perspectives," Damiano says. Different UI scholars each add their own methodologies and perspectives to the discussion. Collaborations may result in journal articles, symposiums and/or policy briefs. One interdisciplinary project has addressed the impact of the Affordable Care Act on health insurance coverage and the health care delivery system.

The PCC encourages student success through education and research experiences. About 100 UI students are funded on PCC research annually. "Being involved in our research projects is an excellent part of the student's learning experience," he says. "It helps fund their education and adds vitality to the center."

In 2007, Dr. Damiano received the Iowa Dental Association Outstanding Service Award and in 2008, he received the Regents Award for Faculty Excellence. The UI Dental Alumni Association and the College of Dentistry recognized him with the 2014 Educator of the Year Award for his dedication to dentistry and public policy.

Hayley Rinehart: Using Research to Step into the Real World of Dentistry

Hayley Rinehart (D4) has always enjoyed science and was attracted to the healthcare field because she wants to help people. She chose dentistry because "I had such a wonderful dentist growing up who always made me feel comfortable in the chair. I was also attracted to the idea of working with my hands, solving problems for patients quickly, and incorporating artistry into my work."

"My experiences in dental research have given me a strong basis in the scientific process," says Hayley, "and my critical thinking skills will help me in my clinical practice someday."

As an undergraduate biology major at the University of Northern Iowa, Hayley participated in genetics research and "fell in love with the investigatory process." During her first year as a dental student, Hayley attended a research seminar given by Dr. Nathan Holton, an anthropologist in the Department of Orthodontics. "I was intrigued by his passion and his anthropological perspective on dental topics," she says, so Dr. Holton became her research mentor.

Inspired by his research, Hayley became interested in learning more about facial and dental form. Dr. Holton introduced her to geometric morphometrics (using a set of landmarks to describe shape) and helped her acclimate to her research projects. "I didn't have much background in the topics I was researching," Hayley explains, "so he was a great resource for me."

Dr. Holton says, "It was a pleasure working with Hayley. We conducted a couple of studies examining craniofacial morphology in subjects with third molar agenesis compared to subjects with third molars. We found some interesting results indicating that third molar agenesis is associated with a number of skeletal differences."

Hayley has enjoyed conducting research independently but still relying on her mentor's guidance when necessary. Collecting data, reviewing literature related to her research, and applying the evidence based concepts she has learned in dental school has provided Hayley with a firm comprehension of her projects.

Including research into her tight schedule as a dental student was challenging but she has become adept with time management. "Research has also forced me to become a more confident communicator through the presentations I've done over the years. It was challenging to be a young dental student while also having to become an 'expert' on topics that were fairly new to me," Hayley says. Being able to offer a concise explanation of her complex research has

required a significant amount of work but has also resulted in a great educational experience for her.

Hayley's research has also provided her with a unique perspective on clinical issues. "I have a greater appreciation for what researchers experience as they try to produce quality studies that can shape clinical practice," she says.

"My experiences in dental research have given me a strong basis in the scientific process," says Hayley, "and my critical thinking skills will help me in my clinical practice someday."

For the 2016 American Association for Dental Research (AADR) Local Research Day at the College of Dentistry, Hayley presented "Third Molar Agenesis and Dental Arch Form: A Three-Dimensional Geometric Morphometric Analysis." She was awarded first place in the 2016 American Dental Association (ADA)/Dentsply Poster Competition and attended the October ADA/Dentsply Student Clinician Research Program meeting as one of 63 attendees from the U.S. and abroad.

"I collected three-dimensional landmark data from dental casts of two groups: a control group with all third molars present, and a group of individuals who were congenitally missing one or more third molars," Hayley explains. "The purpose of the study was to see if the size and/or shape of the dental arches were different between the two groups."

Co-authors on her project included Dr. Steve Miller, Dr. Tom Southard (DEO, Orthodontics), and Dr. Nathan Holton (Orthodontics).

Hayley will be graduating in June 2017 and she is currently looking for an associate position in a general practice. "Where that will take me, I'm not sure," she says. "All I know is that I'm looking forward to graduation and stepping into the real world of dentistry."

Researching Alveolar Ridge Preservation (ARP) to Minimize the Detrimental Effects of Tooth Loss

In dentistry, when a tooth cannot be saved and must be extracted there is a number of detrimental consequences that may affect the patient at a local and systemic level. Tooth loss has several negative aspects. Eating food may be more difficult for the patient, and their speech may be altered. Also, a patient's facial appearance and smile esthetics may be affected, which sometimes results in low self-esteem.

Following tooth extraction, the bone that forms the tooth socket, known as the alveolar bone, inevitably undergoes a process of volume loss that typically peaks within the first 3 to 6 months. Thus, it is important to limit the amount of alveolar ridge loss that follows tooth extraction in order to preserve the natural ridge architecture and/or to facilitate esthetic and functional rehabilitation of an edentulous site or span via dental implants.

> *"What we know about its variable response in the pathogenesis of periodontitis … is truly fascinating … As a clinical researcher, that makes the alveolar bone very attractive to me."*

Dr. Gustavo Avila-Ortiz, a faculty researcher in the Department of Periodontics, became interested in studying interceptive therapies to minimize alveolar bone loss during his specialty training. "The alveolar bone is one of the components of the periodontium. As I learned more about alveolar bone biology, my interest in this part of the attachment apparatus of a natural tooth grew exponentially," he says. "What we know about its variable response in the pathogenesis of periodontitis, as well as its fate after prolonged occlusal trauma or tooth loss, is truly fascinating, but there is so much more that we still do not know about. As a clinical researcher, that makes the alveolar bone very attractive to me."

Currently, Dr. Avila-Ortiz is studying the use of different alveolar ridge preservation (ARP) techniques to minimize the detrimental effects of tooth loss and shorten the amount of healing time needed after tooth extraction prior to placing a dental implant. Although evidence shows that ARP cannot predictably prevent all bone resorption, it can make a significant difference in maximizing the ability of a surgeon to place a dental implant in the ideal restorative position later.

The success of ARP also varies among individual patients, depend-ing, for instance, on the number of extracted adjacent teeth, the integrity of the tooth socket, the features of the alveolar bone (e.g., wall thickness), health issues of the patient (e.g., smoking, diabetes, disorders of the bone), as well as the patient's compliance. While there are several options for ARP, Dr. Avila-Ortiz has studied the combined use of bone substitutes, barrier membranes, and innovative tissue engineering strategies for ARP via socket grafting. ARP via socket grafting involves filling a tooth socket with a biomaterial. Bone substitutes are biocompatible materials that are expected to provide a "support" for the alveolar bone, to prevent the collapse of the ridge, reduce the need for additional grafting, facilitate implant placement, ensure a higher success for the dental implant therapy and, in some cases, minimize the inflammatory response.

Aside from its potential therapeutic benefits, ARP via socket grafting is a valuable clinical research model to study the safety and clinical performance of different biomaterials in function of individual local and systemic factors. In 2014, Dr. Avila-Ortiz and his collaborators at the University of Michigan published the results of a pilot study, which evaluated three different ARP modalities compared with a control: 20 patients were divided into four groups (Group 1, tooth extraction + Collagen plug; Group 2, Allograft + PTFE membrane; Group 3, Allograft + Overbuilding + PTFE barrier; and Group 4, Allograft + Collagen barrier + PTFE barrier). The randomized clinical trial's purpose was to acquire preliminary data about the efficacy of the three ARP techniques when compared to a control. Dr. Avila-Ortiz used the data to conduct a larger trial study involving 60 patients that has recently been completed at the University of Iowa College of Dentistry. This randomized controlled trial has produced relevant evidence pertaining ARP techniques and local topographic factors that influence the outcomes of ARP via socket grafting.

SOCKET HEALING SEQUENCE
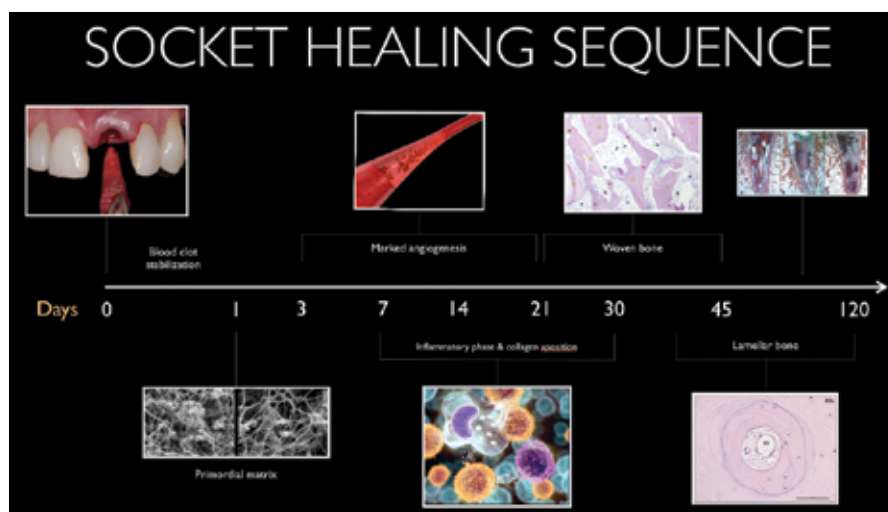
The Big Data Project: Creating an Immense Resource for UI Researchers and Health Care Providers

Dr. Veerasathpurush Allareddy, one of the Big Data Project's researchers

The College of Dentistry & Dental Clinics (CoD), University of Iowa Hospitals and Clinics (UIHC), and the Center for Developmental Disabilities (CDD) have embarked on a collaborative project to link up more than 250,000 unique patient records from the UIHC, CDD and the CoD. The Big Data Project's goal is to create an immense resource for UI researchers and health care providers. A $600,000 three-year grant from the Roy J. Carver Charitable Trust is supporting this goal as part of the Biorepository project.

Associate Dean for Research Brad A. Amendt, Dr. Veerasathpurush Allareddy, a researcher in the Department of Orthodontics, and Mr. Chuck McBrearty, director of the CoD's Dental Technology and Media Services, have been instrumental in organizing this project.

Epic, a medical software application, contains the UIHC medical data while the CoD's axiUm system stores dental health records. A database in the UI Institute for Clinical and Translational Science (CTSA) is hosting the axiUm and Epic data, which will be used for research purposes.

Progeny, a genetic data management software product, will house the patient specimen and pedigree information. Its database fields can be custom designed to accommodate various research projects. Barcoding capability will enable a user to produce a numbering system and track specimens in freezers. Housing RNA and DNA samples from saliva, tissue and tooth samples in Progeny will enable UI faculty and scientists to request patient information on particular medical issues (e.g., periodontitis or diabetes).

"The associations between oral health and systemic health are well documented," says Dr. Allareddy. "The combined data repository has the potential to take this area of research to the next level. Some of our team's recent studies (published in *Bone Marrow Transplantation*, *Journal of Evidence Based Dental Practice*, etc.) have shown that those having dental lesions, such as gingivitis, periodontitis, periapical abscesses, etc., are associated with higher hospital charges and length of stay in hospitals. These patients are also at a higher risk for developing infectious complications following complex surgical procedures."

"Integrating dental and medical records via the combined repository will enable us to examine multiple health-related outcomes at the level of each individual patient, hospital, and society as a whole," Allareddy adds. Better communication between physicians and dentists, he believes, will result in the improved health of patients and communities by creating an inter-professional collaborative practice model that integrates oral and systemic health care delivery. This project, he says, may provide a "causal pathway" for determining the impact of oral health on systemic health (and vice versa), eliminate health disparities, and improve access to care.

In keeping with the 1996 Health Insurance Portability and Accountability Act (HIPAA), information taken from patient records will be limited to only what is necessary for a research project. Each project will require the approval of the University of Iowa Institutional Review Board (IRB).

The Biorepository project's researchers, Dr. Azeez Butali, IIOHR, and Department of Oral Pathology, Radiology and Medicine; Dr. Arwa Owais, Department of Pediatric Dentistry; and Dr. Veersathpurush Allareddy, Department of Orthodontics, are already benefiting from the combined datasets. "To date we've been able to merge data for about 250,000 individuals," says Butali. "This dataset will support our R21 grant, which is studying the impact of systemic diseases on oral health, and our Precision Medicine Grant in 2017. We'll be able to recall subjects with existing data for biological samples, to improve health outcomes."

Karen Kluesner and Amber Marolf are collecting the saliva, teeth and tissue samples. Karen calls Progeny "the Cadillac of databases" and says, "It's important to think ahead, to anticipate what types of information researchers might want in the future." In talking with different departments at the CoD, the biorepository management team has received positive feedback about using the project's big data for possible future research projects.

Dr. Allareddy agrees and envisions many future research projects. "This is an exciting time to conduct big data analyses," he says. "The possibilities are numerous."

Creating a Biorepository for Groundbreaking Research, Precision Medicine and Improved Patient Health

Dr. Azeez Butali, Iowa Institute for Oral Health Research and Department of Oral Pathology, Radiology and Medicine, received a three-year, $597,645 Roy J. Carver Charitable Trust grant to develop a biorepository for research into oral health and disease. The purpose of the biorepository is threefold:

1. To establish a biorepository that will combine biological materials, dental records and medical records;

2. To establish a fully integrated medical, genetic and dental patient record, to improve quality of care provided to the patients, as well as enhance broader quality research across the University of Iowa medical and dental facilities;

3. To make these data and biological materials available to researchers at the University of Iowa and collaborators in order to conduct ground-breaking research, to deliver personalized precision medicine and improve patients' health.

Current Project Status: The award is supporting the collection of 12,500 biological samples that include saliva, teeth, oral tissues, and dental and medical information from 10,000 individuals. To date, over 300 samples have been collected and the pipeline for ensuring the smooth collection of materials has been optimized. The integration of medical and dental information in Axium and Epic has also been completed for 250,000 individuals. The biorepository is now fully operational and open to all researchers within the University. This resource will be supporting an R21 and U24 grant application in the spring of 2017.

Three abstracts describing the development, integration and future use of the biorepository were presented at national and international meetings in 2016.

Dr. Butali is principal investigator. Drs. Arwa Owais, Department of Pediatric Dentistry, and Veerasathpurush Allareddy, Department of Orthodontics, are co–principal investigators.

Photo (left to right): Drs. Veerasathpurush Allareddy, Arwa Owais, and Azeez Butali
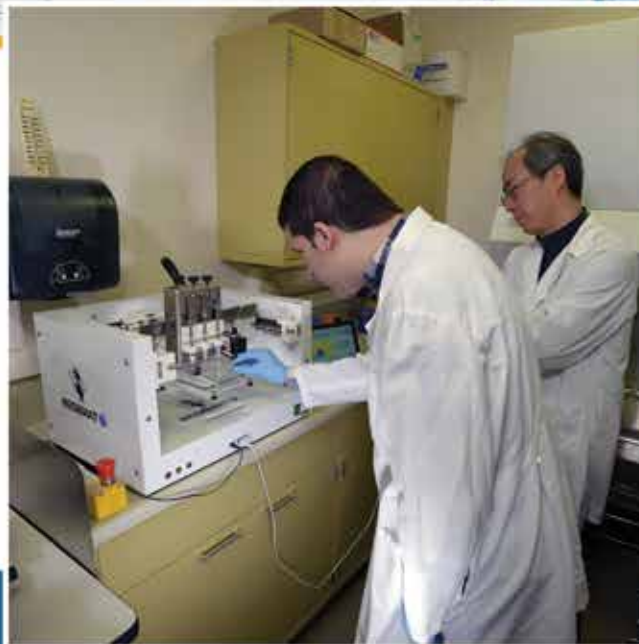
MicroCT Imaging: Detailed Visualization & Quantitative Analysis

3D Bioprinting: Driving Innovation in Regenerative Dentistry

In the fall of 2014, the College of Dentistry acquired a Skyscan 1272 microCT scanner. MicroCT imaging is similar to conventional CT imaging used in hospitals, but a microCT scanner is able to image objects on a much smaller scale.

The Skyscan 1272 is capable of producing scans with voxels as small 0.35 microns for objects as large 75mm in width and 100 mm in height. Purchased with a grant from the Carver Charitable Trust, the Skyscan 1272 gives researchers at the College of Dentistry the capability to non-destructively image the external and internal structure of objects at the submicron level. Once an object is placed inside the scanner, it slowly rotates while hundreds of x-ray images are collected at different angles. Using one of the College's microCT computer workstations, these images can then be reconstructed into a stack of cross-sectional slices that allow for detailed visualization and quantitative analysis. The entire process—from scan acquisition to analysis—is surprising user-friendly.

Along with the microCT scanner, the college also acquired an automatic sample changer that can hold as many as 16 samples. Once the samples are mounted in the changer, they are scanned one-by-one, and can even notify the user via email when the scans are completed.

To date, researchers at the College of Dentistry have used the Skyscan 1272 for a wide range of research applications, including the analysis of craniofacial phenotypic variation, detailed studies of dental microstructure, and the development of bone regenerating scaffolds.

3D bioprinting is driving major innovations in many medical areas, such as biomedical engineering, regenerative dentistry and pharmaceutics. This technology is used to biofabricate 3D living constructs by the precise spatial positioning of cells, hydrogels and biochemicals, also known as 'bioink.' 3D bioprinting allows manufacturing of tissue constructs created to the patient's own specifications by using their own stem cells or biomaterials. The main technologies used for the deposition of biological materials are inkjet, microextrusion, and laser-assisted printing. The College of Dentistry and the Iowa Institute for Oral Health Research recently acquired the REGEMAT3D V1 (Fig. 1), a micro-extrusion-based bioprinter, which can print a variety of 3D shapes of hydrogels and cell types using a computer-aided manufacturing software program. A precision XYZ robot is equipped with 3 microextrusion dispensing heads and 1 fused deposition modeling head. Pre-loaded bioink cartridges are printed using a mechanical-based dispensing system, producing both good printability and high cell viability. A temperature-controlled head allows printing of a variety of thermoplastic polymers designed as biomaterial for guided bone tissue engineering, or as scaffold for bioprinted tissue constructs.

The tissue regeneration group at Iowa is applying bioprinting in dental and bone repairs -- focusing on the development and characterization of new bioink formulations. These formulations can be applied in oral and maxillofacial surgery, such as oral mucosa engineering, dental pulp and dentin regeneration, or socket grafting and bone reconstruction. The group's goal is to fit patients with living bioprinted teeth or with customized hard or soft graft for complex facial reconstruction, like cleft lip and cleft palate repair.

The Biostatistics and Research Design Unit: Providing a Vital Service to Dental Researchers

Dr. Deborah Dawson

Dr. Fang Qian

Derek Blanchette

The division of Biostatistics and Research Design provides a vital service to dental faculty, predoctoral and graduate students, and staff who conduct research at the College of Dentistry & Dental Clinics. Dr. Deborah V. Dawson, who directs the unit, is also a Pediatric Dentistry faculty.

Dr. Dawson brings over 35 years of experience to her biostatistics department: statistical evaluation of clinical, basic science, and epidemiologic research data; statistical genetic modeling of human dental, developmental, and immune and inflammatory disorders; and meta-analysis.

Dr. Fang Qian, who is also an adjunct faculty in the Department of Preventive & Community Dentistry, is experienced in economic and large data base analysis. She provides statistical assistance to predoctoral and graduate students who are involved in research.

Biostatistician Derek Blanchette offers data quality, relational database design, survey design and analysis, nonparametric statistics, statistical computing, and experimental design.

Biostatistics and Research Design staff assist with the study design, writing statistical analysis plans, estimating power and sample size requirements, grant proposals, Institutional Review Board (IRB) applications for studies with human subjects, Office of the Institutional Animal Care and Use Committee (IACUC) applications for studies using animals, biographical sketches or letters of support, assistance with resources and environment, and acting as a mock reviewer.

"We provide a statistical analysis plan," says Dr. Dawson. For grant proposals, IRB or IACUC applications, a statistical analysis plan addressing sample size is needed. For experimental studies, a randomization plan is essential. Here are some tips for researchers:

1. A student's first meetings with Dr. Qian should also include their mentor.

2. Include a biostatistician at the beginning of your project: for a small grant (R21), one month prior to submission; for a medium grant (R01), two months prior; and for a large grant (Po1, U01), three months prior.

3. Include the level of supported effort for the biostatistician(s) on your grant proposal and have it approved by Associate Dean for Research Brad A. Amendt.

4. Don't change or remove the biostatistician's name after being officially listed on a grant proposal, unless permission is received from Research Administration.

5. Include financial support for the biostatistician(s) and/or graduate assistant.

6. For data management or computer systems analysis, see personnel who can support these functions.

Giving the Biostatistics Unit sufficient time to do their best for researchers will strengthen the research. The pitfall of not heeding this advice is reflected in one of Dr. Dawson's favorite quotes:

"To call in the statistician after the experiment is done may be no more than asking him to perform a post-mortem examination: he may be able to say what the experiment died of."

—Sir Ronald A. Fisher during his presidential address to the First Indian Statistical Conference, Calcutta, 1938
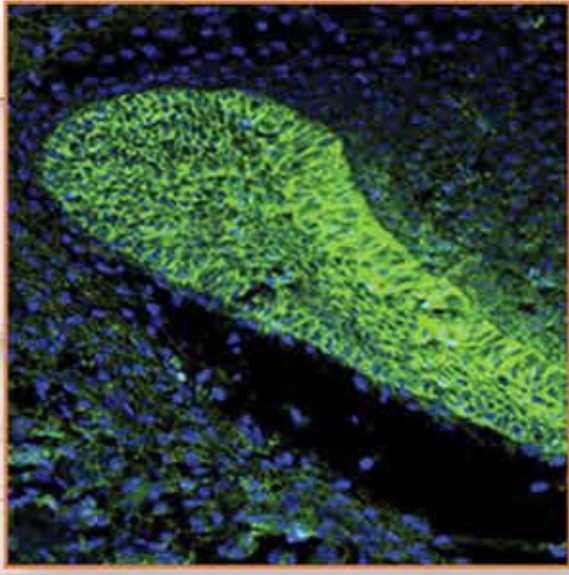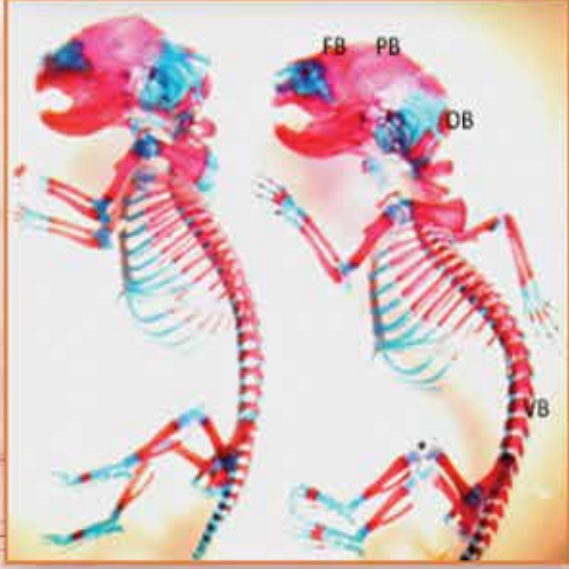
WELCOME!

Research Day 2017

Dear Colleagues:

Thank you for participating in the 64th Anniversary of the University of Iowa College of Dentistry's Local Research Day on February 14, 2017. Research is central to our mission and to the culture of inquiry that it supports. This day is one of the highlights of our 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. Deborah S. Kacmarynski as our keynote speaker. Dr. Kacmarynski is the Paul N. Johnson Associate Professor of Craniofacial Abnormalities in the Department of Otolaryngology – Head & Neck Surgery at the University of Iowa Hospitals and Clinics. She is the leader and co-director of the Cleft and Craniofacial Team, and she participates in research with an excellent collaborative group of UI faculty, including a very strong partnership with faculty at the College of Dentistry.

Our College has been very successful in recruiting bright and talented faculty during the past few years. This success includes faculty with significant interests in tissue engineering, ceramics, genetics, malocclusion, health policy, as well as translational and clinical research. This infusion of new ideas has produced new avenues of research and mentoring opportunities across our pre-doctoral, clinical post-doctoral, and graduate programs. It is an exciting time for the College's future!

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

Best wishes,

David C. Johnsen, D.D.S., M.S.
Dean

February 14, 2017

Dental Research participants and Iowa Section of AADR:

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

The CoD engenders language and methodology fundamental to the evolving disciplines of biotechnology, environmental health, commercialization, and the transfer of new data from bench to clinic to industry. Research at the CoD promotes the translation of basic life sciences, including genomics and proteomics, to dental and medical sciences.

Through this symposium, we recognize (and learn about) our current research programs and the great research that has been accomplished. Our students, post-doctoral associates, residents, faculty and staff have worked together to discover new and novel scientific paradigms. We have a highly visible position within the University of Iowa, and we continue to improve our standing through competitive dental research programs.

On this occasion, the CoD is pleased to honor both the talent and commitment of our students, residents, faculty, and staff and the American Association for Dental Research. We take great pride in their success and believe that their contributions, insights, vision, determination, and dedication will shape the future of dentistry.

This year we are honored to have Dr. Deborah Kacmarynski, MD, MS as our featured keynote speaker. She is the director of the Cleft and Craniofacial Team at the Carver College of Medicine, Department of Otolaryngology. Her research focuses on the development of new technologies and procedures to repair cleft palate in her surgical practice. She and her team provide healthcare to patients with craniofacial anomalies. As a friend of the College, she works with multiple faculty members to promote oral health. She has received numerous awardsfor research, teaching and service and was recently honored with the Paul N. Johnson Professorship in Craniofacial Abnormalities.

Warmest Regards,

Brad A. Amendt, Ph.D.   Kim Brogden Ph.D.
Associate Dean for Research   Director, IIOHR
College of Dentistry and Dental Clinics   College of Dentistry and Dental Clinics
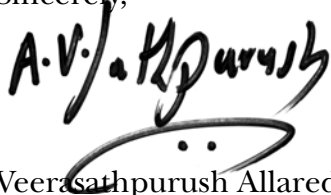
Dear Colleagues,

On behalf of the Iowa Section of the American Association for Dental Research (AADR), welcome to the 64th annual University of Iowa College of Dentistry & Dental Clinics Annual Research Day.

Today, colleagues and students present their exciting research findings, ranging from basic, translational, clinical, health policy, and services research. This event underscores the breadth of research at our College and represents a unique moment to observe and invigorate the research conducted here.

We welcome Dr. Deborah Kacmarynski as the keynote speaker. She is the Paul N. Johnson Associate Professor in Craniofacial Abnormalities in the Department of Otolaryngology - Head & Neck Surgery at UI Hospitals & Clinics. Her practice includes pediatric otolaryngology and cleft and craniofacial surgery, she partners with Pediatric Neurosurgery to perform craniosyn-ostosis repairs and other craniofacial surgeries, is co-director of the Iowa Cleft and Craniofacial Team, and collaborates with dental and UI faculty. Dr. Kacmarynski will present "Oral Clefting: Opportunities for the Next Score."

We thank the presenters, volunteering judges, and support staff for their support in making this event successful. We also sincerely thank all of the sponsors who have generously contributed to this year's event. Your support makes this day possible.

Sincerely,

Veerasathpurush Allareddy BDS PhD
Associate Professor
Department of Orthodontics
President Pro Tem, Iowa Section of AADR

Kyungsup Shin DMD, PhD, MS
Assistant Professor
Department of Orthodontics
Vice-President, Iowa Section of AADR

Sharon Seydel
Department Administrative Manager
Iowa Institute for Dental Research
Secretary/Treasurer Iowa Section of AADR

Program

Iowa Section of the American Association for Dental Research (AADR)
64th Annual Meeting, Tuesday, February 14th, 2017

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. Veerasathpurush Allareddy
8:20 a.m.	**Keynote Address** Dr. Deborah S. Kacmarynski
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) Evidence-Based Research Session (Oral-B Classroom N212)
11:30 a.m. – 12:40 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

(a)   Max Smith Pre-Doctoral Competition
(h)   Iowa Society of Periodontology Pre-Doctoral Award

1.   **Arwa I. Owais**, A. Butali, Vs. Allareddy

 Iowa Biorepository: A Unique Opportunity for Precision Medicine and Collaborative Research

2.   **Azeez Butali**, R. Cornell, H. Liu, T. Busch, J.C. Murray

 Damaging GRHL3 Mutations in the Sumoylation and CK1 Phosphorylation Sites Identified in Cleft Palate from Africa Have Functional Effects on Danio Rerio

3. [a]   **Frankie Y. Chyi**, *J.J. Warren*

 Factors Associated with Toothpaste Use among Low-Income Families

4. [a]   **Maria P. Gomez Hernandez**, A.M. Bates, E.E. Starman, T. Abbasi, S. Vali, *K.A. Brogden*

 HBD3 Induced PD-L1 Expression in HNSCC

5. [a]   **Stacey Howes**, *Vs. Allareddy*

 Longitudinal Trends in Hospital-Based Emergency Department Visits Involving Periapical Abscesses

6. [a,h]   **Madeline Swenson**, *G. Avila Ortiz, C. Barwacz*

 Peri-Implant Mucosa Dynamics around Divergent and Concave Abutment Transition Profiles

Oral Session 2

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

(b)   Max Smith Graduate and Post-Doctoral Competetion
(n)   Orthodontics Post-Doctoral Award
(r)   Basic Science Post-Doctoral Award

7.   T.S. Ghazal, **Daniel J. Caplan**, H. Cowen

 Anterior Restoration Longevity among Nursing Facility Residents (30-Year Retrospective Study)

8. [b,n]   **Sheila M. Daniels**, P. Brady, A. Daniels, S. Howes, K. Shin, S. Elangovan, *Vs. Allareddy*

 Comparison of Surgical and Non-Surgical Orthodontic Treatment Approaches on Occlusal and Cephalometric Outcomes in Patients with Severe Class II Division I Malocclusions

9. [b,r]   **Mason E. Sweat**, S.L. Eliason, W. Yu, *B.A. Amendt*

 A Sox2-Lef-1 Protein Interaction Inhibits Lef-1 Transcriptional Activity and Wnt Signaling during Odontogenesis

10.[b,o] **Kaitlin J. Hoogeveen**, *D.V. Dawson, D.R. Drake, K. Weber-Gasparoni*

    Significance of Perinatal Oral Health in an American Indian Population

11.[b,r] **Amber M. Bates**, *K.A. Brogden*

    Matrix Metalloproteinase Responses of HNSCC and Immune Cell Transwell Co-Cultures

12.[r] **Adil Akkouch**, *B.A. Amendt*, H. Liu

    Three-Dimensional Printed Composite Scaffolds Enhance *in vivo* Bone Regeneration in Rat Critical-Sized Calvarial Defect

Oral Session 3

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

- (b) Max Smith Graduate and Post-Doctoral Competetion
- (g) Endodontic Michel Fuller Post-Doctoral Award
- (j) Operative Dentistry Post-Doctoral Award
- (r) Basic Science Post-Doctoral Award

13. **Ryan J. Ries**, W. Yu, S.L. Eliason, H. Cao, *B.A. Amendt*

    ***In vivo* Inhibition of microRNA (miR) Using a Novel miR Inhibitor System Reveals a Role for miR-17-92 in Palatogenesis**

14.[b,g] **Lauren E. Jensen**, *O.A. Peters*, S. Murphy, A.E. Williamson, W.T. Johnson, F.B. Teixeira

    Mechanical Preparation of Oval-Shaped Root Canals in Mandibular Premolars with the TRUShape 3D Conforming File: A Micro-Computed Tomography Study

15.[b,r] **Miguel Romero-Bustillos**, W. Yu, S.L. Eliason, *B.A. Amendt*

    The Role of Iroquois Homeobox 1 (Irx1) in Root Development

16.[b,j] **Tracy A. D'Antonio**, *R. Maia*, M.A. Vargas, F. Qian, F.N. Skiff

    Visual Vs. Spectrophotometric Analysis for Bevels in Class IV Restorations

62.[b,r] **Steven L. Eliason**, M. Romero-Bustillos, N.E. Holton, *B.A. Amendt*

    microRNA-26b-5p Targets Lef-1 to Regulate Molar and Incisor Development

Pre-Doctoral Posters

11:30 a.m. - 12:40 p.m., Iowa Institute for Oral Health Research, W220 A/B

17. **Walker D. Clark**, *M.K. Geneser*, A.I. Owais, M.J. Kanellis, F. Qian

  A Comparison of the Hall and Conventional Stainless Steel Crown Techniques in Primary Molars. A Retrospective Study

18. [d,e] **Andrew D. Richter**, *N.E. Holton, T.E. Southard, C.L. Nicholas*

  Absolute Tooth Length and Predicting the Timing of Dental Eruption

19. [d,e] **Samantha Resnick**, *T.A. Marshall*, W. Liu, J.J. Warren, D.V. Dawson, K.R. Phipps, D.E. Starr, D.R. Drake

  Associations Between Beverage Characteristics and Caries Experience in American Indian Children

20. [d,e] **Deborah Yu**, *E.C. Teixeira*

  Characterization of a Polydopamine Coating on Dentin

21. [d,e] **Karley R. Brantman**, *R. Maia*, E. Ismail, F. Qian

  Comparing Light Propagation between Dental Tissues and Resin-Based Composites

22. [d,e] **Flora Y. Yen**, F. Qian, D. Lynch, A. Villhauer, *D.R. Drake, J.A. Banas*

  Competitiveness of Mutans Streptococci Species Isolated from American Indians

23. [d,e] **Alison R. Christensen**, *A.I. Owais*, K. Weber-Gasparoni, D.R. Blanchette, *D.V. Dawson*

  Deciduous Teeth Eruption in Premature vs. Full-Term WIC-Enrolled Children

24. **Sean D. McGivern**, *S.M. Levy*

  Descriptive Analysis of Patient and Practitioner Trends at the Dr. Rhys B. Jones Dental Health Center

25. [d,e] **Brooke Brown**, *T.A. Marshall*, M.R. McQuistan, M.A. Cunningham-Ford

  Development of a Survey to Assess Diet-Related Oral Health Knowledge

26. [d,e] **Taylor Postler**, D. Lynch, A. Villhauer, W. Liu, D.V. Dawson, J.J. Warren, T.A. Marshall, K.R. Phipps, D.E. Starr, *D.R. Drake*

  Genotypic Diversity of *Streptococcus sobrinus* in American Indian Mother-Child Pairs

27. [d,e,h] **Erica N. Recker**, D.J. Caplan, D.V. Dawson, W. Liu, H. Cowen, J. Hartshorn, *L. Marchini*

  Iowa Nursing Facility Oral Hygiene Intervention: A Pilot Study

28. [d,e] **Amanda Piche**, *N.E. Holton*, T. Yokley

  Morphological Integration of the Nasal Region

29.[d,e] **Leah Barshinger**, *M.K. Geneser*, B. Levy, J. Murph, J.M. Daly, F. Qian, *K. Weber-Gasparoni*

Oral Health Instruction and Practices among Iowa Family Physicians/Pediatricians

30.[d,e] **Noah C. Hollinger**, *K. Leary*, F. Qian, M.J. Kanellis, K. Weber-Gasparoni

Outside Referral Patterns to the Pediatric Dental Clinic

31. **Sherri Chyi**, *P.W. Wertz*, F. Qian

Oxidation of Blue Dye with Hydrogen Peroxide as a Function of pH

32.[d,e] **Amanda T. Phan**, *K. Leary*, A.I. Owais, F. Qian, *K. Weber-Gasparoni*

Parental Language Barriers and Oral Health Behaviors among WIC Children

33.[d,e] **Nicole Krois**, A. Kossioni, P. Barlow, C. Straub-Morarend, *L. Marchini*

Preliminary Validation of a European Instrument to Measure Clinical Learning Environments for Dental Students (DECLEI) in an American Dental School

34.[d,e] **Michelle Tsai**, *J.A. Banas*

Selective Toxicity of Oral Therapeutics against Oral Streptococci *in vitro*

35. *L. Marchini*, **Joshua Colvin**, *D.V. Dawson*, C. Childs

Systematic Review of Factors Associated with Conventional Complete Denture Dissatisfaction and Intolerance

36.[d,e,h] **Grant McCaulley**, *J.A. Banas*, W. Liu, D.V. Dawson

Testing the Impact on Oral Malodor of Adding Dental Probiotics to an Oral Hygiene Regimen

37.[d,e] **Madison M. Kasparek**, *T.A. Marshall*, D. Blanchette

Feasibility and Application of ASA 24 in Dental Nutrition Research

38. **Ryan J. Rucker**, *L. Marchini*, P. Barlow, J. Hartshorn, L. Kaufman, B. Smith, A. Kossioni

Validation of a New Scale to Assess Ageism among Dental Students

61.[d,e] **Elliott Glenn**, *S.R. Armstrong*, S. Geraldeli, M. Nascimento, F. Qian, J. Jessop, R. Maia, E.C. Teixeira

Effect of Arginine on Conversion of an Experimental Dental Adhesive

Graduate, Faculty & Staff Posters & Table Clinics

11:30 a.m. - 12:40 p.m., Iowa Institute for Oral Health Research, W220 A/B

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(d) Procter and Gamble Award
(f) ADA Table Clinics Post-Doctoral Award
(g) Endodontic Michel Fuller Post-Doctoral Award
(i) Iowa Society of Periodontology Post-Doctoral Award
(j) Operative Dentistry Post-Doctoral Award
(l) Oral & Maxillofacial Radiology Post-Doctoral Award
(n) Orthodontics Post-Doctoral Award
(o) Pediatric Dentistry Post-Doctoral Award
(p) Preventive and Community Dentistry Post-Doctoral Award
(q) Prosthodontics Post-Doctoral Award
(r) Basic Science Post-Doctoral Award

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39.   **Raymond A. Kuthy**, S.C. McKernan, M. Pooley, M.N. Nguyen

     Differences between Communities with One or No General Dentist

40.   J. Shenkin, C. Spanbauer, A. Szabo, **John J. Warren**, C. Okunseri

     Hospital Emergency Department Visits by Ambulance for Tooth Pain

41.[r]   D. Seol, **InO Song**, A. Lehman, B. Marc, K. Gail, J. Martin, *K. Shin*

     Reparative Potential of Migratory Progenitor Cells in Injured Mandibular Condyle Cartilage and Articular Disc

42.   *V. Allareddy*, **Suvendra Vijayan**

     Accuracy of Using Automatic or Blended Techniques for Mandibular Segmentation

43.[d,f]   **Ursula A. Diehl**, M. Zhu, D. Blanchette, *J.A. Banas*

     Analysis of Low pH Streptococci from Early Dental Decay in Children

44.   **Daniah Alhazmi**, G. Axt, S.L. Sousa Melo, *V. Allareddy*

     Comparative Study of Dosimetry in Two Cone Beam CT Devices

45.[f,g]   **Emily Case**, *A.E. Williamson*, W. Johnson, W. Liu, F. Qian

     Endodontic Board Certification: A Review of Factors Affecting the Certification Rate

46.[f,g]   **Chase Wicker**, *F.B. Teixeira*, A.E. Williamson, F. Qian

     Evaluation of a Thermal Pulp Sensibility Test on Crowned Teeth

47.[f,q]   **Kan Wongkamhaeng**, *D.V. Dawson, J.A. Holloway, I. Denry*

     Surface Modifications of Zirconia on In-Depth Transformations and Flexural Strength

48.[f,j]   **Amira Ahmed**, *J.L. Kolker, S. Guzman-Armstrong*, J.J. Warren, F. Qian

     Management of Initial Caries Lesions: An Iowa Survey

49.[f,l]   **Shawn Countryman**, *V. Allareddy*, S. Sousa Melo, M. Belem

     Observer's Performance in Detecting Caries-Like Lesions on Multiple Displays

50.[f,o] **Brandy Kleinheksel**, *K. Leary, K. Weber-Gasparoni*, F. Qian, A. Stier

Pediatricians' Behavior, Comfort, and Knowledge after Infant Oral Health Training

51.[f,g] **Daniel J. Bartling**, *A.E. Williamson*, W. Liu, F. Qian

Prevention of Tooth Discoloration Using Dentin Tubule Coverage: An *ex vivo* Study

52.[f,j] **Paula Ortega-Verdugo**, *J.J. Warren*, J.L. Kolker, K.D. Carter, S. Guzman-Armstrong

Retrospective Study of Factors Associated with Success of Stepwise Excavation

53.[f,p] **Nyla Balakrishnan**, *S.M. Presson*

Select State Initiatives on Integrating Oral Health and Chronic Disease

54.[f,g] **Benjamin M. Nashleanas**, *A.E. Williamson*, F. Qian, F.B. Teixeira

Survival of Molar Root Canal Therapy in Pediatric Patients: A Retrospective Analysis

55.[r] **Wenjie Yu**, *B.A. Amendt*, S.L. Eliason

Pitx2 Controls DESC Proliferation and Differentiation by Targeting the Dental Epithelial Signaling Center

56.[f,j] **Watcharaphong Ariyakriangkai**, *S.R. Kwon, D.V. Dawson*, M.A. Vargas, P.W. Wertz

Hydrogen Peroxide Penetration and Tooth-Whitening Efficacy of Innovative Double-Layer Technique

57.[f,j] **Watcharaphong Ariyakriangkai**, *M.A. Vargas*

CAD/CAM Resin-Bonded Fixed Partial Dentures (RBFPDs)

58.[f,i] **Sarah A. Rinehart**, *G. Avila Ortiz*

Alveolar Ridge Healing and Dimensional Changes Following Tooth Extraction

59.[f,n] **Lina Alsibaie**, S. Howes, K. Shin, *Vs. Allareddy*

Non-Surgical Treatment Strategies and Outcomes in Patients with Severe Class II Division I Malocclusions

60. **Kelsey Tengan**, *G. Avila Ortiz*

Prospective, Comparative Assessment of Alveolar Ridge Preservation Using Guidor® Easy-Graft® Classic in Atraumatic Extraction Socket

Evidence-Based Research Session

Presentations by D3 students (Moderator: Teresa Marshall)
9:30 a.m. - 11:45 a.m., Oral-B Classroom N212

Abstracts

1. Iowa Biorepository: A Unique Opportunity for Precision Medicine and Collaborative Research

Arwa I. Owais[1], A. Butali[1], Vs. Allareddy[1]

[1]University of Iowa, Iowa City, IA

With the recent decision by the Obama Administration to promote precision medicine in order to improve the health of Americans, it has become critical and expedient for dental scientists and clinicians to adopt this national position. The College of Dentistry - University of Iowa have established a dental biorepository that combines a DNA bank with dental and medical records of all patients visiting the dental clinic at the College. The aims of the biorepository include: To establish a biorepository that will combine biological materials, dental and medical records; establish a fully integrated medical, genetic and dental patient record to improve quality of care provided to the patients and enhance broader quality research across the University of Iowa medical and dental facilities; and to make these data and biological materials available to researchers in order to conduct ground breaking research to deliver personalized precision medicine and thereby improve patients' health.

Iowa's Biorepository will provide support for various research areas such as: Bioengineering, Tissue Engineering, Stem Cells, Craniofacial, Oral Biology, Genetics and Dental Development; Immunology, Microbiology, Caries and Microbiome Research; Public Health & Epidemiology. It will help by identifying genetic loci causing elevated risk for a disease and knowledge of factors that modifies these risks, opens opportunities for prevention and improved treatment.

This initiative will fully embrace the era of personalized medicine using the knowledge of genetics and clinical influences to bring about focused and improved clinical care.

2. Damaging GRHL3 Mutations in the Sumoylation and CK1 Phosphorylation Sites Identified in Cleft Palate from Africa Have Functional Effects on *Danio rerio*

Azeez Butali[1], R. Cornell[1], H. Liu[1], T. Busch[1], J.C. Murray[1]

[1]University of Iowa, Iowa City, IA

Objectives: Cleft palate only (CPO) affects 1 in 2,500 live births world-wide and it is associated with long-term morbidity and in some cases mortality. Several genes have been reported in the etiology of CPO. Recently, two independent studies identified a common coding variant in GRHL3 to be associated with risk for nonsyndromic CPO in Europeans (Leslie et al., 2016, Mangold et al., 2016).

Materials and Methods: This study is part of the African Craniofacial Anomalies Network where we recruit case-parent trios, cases and other family members, as well as controls from Ghana, Ethiopia and Nigeria. From our cohort, we identified individuals with CPO and conducted Sanger sequencing on exons of the Grainyhead light 3 (GRHL3) gene in DNA from 134 non-syndromic CPO and parent samples when available to identify *de novo* variants. Our analyses pipeline was to identify novel variants, which were then confirmed in the reverse direction. A total of 270 controls, i.e. 90 each from Ghana, Ethiopia and Nigeria, were also sequenced. We tested patient-derived GRHL3 mutations zebrafish and in cells.

Results: Six novel mutations were identified in cases. None was found in 270 controls or in any known exome, and whole genome databases including the 1000 genomes database that has data from Africa. These mutations include: 3 missense (p.Pro120His, p.Asp364Gly and p.Arg603Lys), 1 splice site (p.Ser381Arg), a deletion (p.A111del), and 1 nonsense mutation (p.Tyr513X). The p.Asp364Gly located in the sumoylation site show dominant negative effect, while the p.Ser381Arg in the CK1 Phosphorylation site, as well as the nonsense mutation p.Tyr513X, exhibited low activity compared with wild type GRHL3. These results are consistent in both *in vivo* and *in vitro* experiments.

Conclusions: The characterization of these variants suggests that individuals carrying functional mutations in GRHL3 will show an increased susceptibility to the development of CPO. We believe that these findings will add to existing knowledge in the field and could lead to early diagnosis, preventive measures and potential novel gene therapy for CPO

3. Factors Associated with Toothpaste Use among Low-Income Families

Frankie Y. Chyi[1], *J.J. Warren*[1]

[1]University of Iowa, Iowa City, IA

Objectives: Children from low-income families have a higher risk of having poor oral health. The purpose of this study was to determine access to toothpaste and toothpaste use patterns in children from low-income families and whether toothbrushing habits are related to family income, education or other factors.

Methods: A pilot study was conducted at the Johnson County WIC Clinic in Iowa City. Parents of children 0-5 years of age were recruited in the waiting room and asked to complete a questionnaire regarding one of their children. The questionnaire included items regarding frequency of toothbrushing, whether toothpaste was used when their child's teeth was brushed, if they have trouble obtaining toothbrushes or toothpaste because of cost, and knowledge of fluoride. Data from the collected questionnaires were entered into Excel and used to generate descriptive statistics. Chi-square tests were done to assess relationships between regular brushing and independent variables.

Results: 75 questionnaires were completed for this pilot study. Children ranged in age from 1-5 years, but most were 3 years old or younger. All respondents reported annual family incomes of $20,000 or less, with many (46%) having incomes of $10,000 or less. The majority of respondents (91%) reported that they did not regularly use toothpaste for their child, and only 43% of the children brushed their teeth once per day or more. 39% of the participants reported trouble obtaining toothbrushes or toothpaste because of cost. Bivariate analyses found that parents who did not think fluoride was harmful, and thought it was important when buying toothpaste were more likely to have their kids brush once per day or more.

Conclusion: Access and use of toothpaste, and lack of regular toothbrushing appears to be a significant problem in this population, and infrequent brushing was related to lack of knowledge about toothpaste and fluoride.

4. HBD3 Induced PD-L1 Expression in HNSCC

Maria P. Gomez Hernandez[1], A.M. Bates[1], E.E. Starman[1], T. Abbasi[80], S. Vali[80], *K.A. Brogden*[1]

[1]University of Iowa, Iowa City, IA; [80]Cellworks Group, Inc., CA 95070, USA

Objectives: Human β-defensin 3 (HBD3) is present in high concentrations in the oral cavity of individuals with head and neck squamous cell carcinomas (HNSCC). The objectives of this study were i) to determine if HBD3 contributes to HNSCC pathogenesis by inducing programmed death-ligand 1 (PD-L1) expression on HNSCC cell lines and ii) to identify putative pathways involved in HBD3-induced PD-L1 expression.

Methods: HNSCC cell lines SCC4, SCC15, SCC19, SCC25, and SCC99 (5.0×10^4 viable cells) were incubated without and with 0.6 µM IFNγ, a well-known PD-L1 inducer used as a positive control, and 0.2, 2.0, or 20.0 µM HBD3 for 24 hours. Cells were stained with anti-human APC-CD274 and Live/Dead Fixable Green Dead Cell Stain. Unstained cells and cells stained with an isotype antibody were included as controls. Cell suspensions were then examined using an LSR II Violet Flow Cytometer. Flow cytometric data was analyzed using FlowJo software. A one-way ANOVA followed by the Tukey's HSD test was used to determine differences ($p < 0.05$). An integrated cancer cell network was used to predict signaling pathways for HBD3-induced PD-L1 expression.

Results: Untreated HNSCC cell lines contained lower levels of PD-L1 on their surfaces. Treatment with 0.6 µM IFNγ increased the number of cells expressing PD-L1. Treatment with 20.0 µM HBD3 also increased the number of cells expressing PD-L1, and these results not significantly different than IFNγ-induced PD-L1 expression ($p > 0.05$). HBD3-induced PD-L1 expression may signal via CCR6, Gi, LYN, PI3K, PIP3, AKT, MTOR, S6K PD-L1, sharing intermediates with IFNγ starting at PI3K.

Conclusion: HBD3 increases the number of cells expressing PD-L1, a finding that suggests HBD3 may play an immunosuppressive role in the pathogenesis of HNSCC.

5. Longitudinal Trends in Hospital-Based Emergency Department Visits Involving Periapical Abscesses

Stacey Howes[1], *Vs. Allareddy*[1]

[1]University of Iowa, Iowa City, IA

Background: Untreated periapical abscesses may advance to lesions that are severe enough to require hospital emergency visits. The objective of this study is to examine longitudinal trends in hospital based emergency department visits (ED) due to periapical abscess.

Methods: The Nationwide Emergency Department Sample for the years 2008 to 2013 was used. All ED visits with a diagnosis of periapical abscess were selected. Panel data analysis was conducted to examine longitudinal changes and trends associated with outcomes.

Results: During the study period, 2,959,940 ED visits contained a periapical abscess diagnosis which is about 0.4% of all United States emergency department visits. The number of ED visits per year increased from 460,260 in year 2008 to 525,856 in year 2013. Patients who were uninsured made up about 40.7% of ED visits. A vast majority of patients resided in low income areas. Within the study period, 54 patients died in hospital EDs. The average hospital emergency department charge per visit was approximately $1,060 and increased throughout the study period. The total emergency department charges across the United States during the 6-year study period was $2.8 billion. Close to 5% were hospitalized following the ED visit. The mean hospitalization charge for this cohort was close to $34,000 and the mean length of stay was 4 days. The total hospitalization charges across the entire United States was $4.6 billion.

Conclusions: ED visits due to periapical abscess seem to be increasing during the 6-year study period thus causing a strain on the healthcare system. An extensive amount of hospital resources are used to treat periapical abscesses through the emergency department and patients are likely to acquire high charges.

Practical Implications: Preventive health programs should be instituted to high risk populations with poor oral health.

6. Peri-Implant Mucosa Dynamics around Divergent and Concave Abutment Transition Profiles

Madeline Swenson[1], *G. Avila Ortiz*[1], *C. Barwacz*[1]

[1]University of Iowa, Iowa City, IA

Objectives: An implant abutment serves as a transitional prosthetic component from a cylindrical implant to the anatomical form of the clinical crown, traversing the soft tissues and affecting the peri-implant mucosal architecture. The objective of this study was to compare the influence of two abutment transition zone morphologies on mid-facial soft tissue dynamics associated with maxillary anterior implant restorations one year after abutment connection.

Methods: Of 56 subjects in the study population, 29 who have completed the one-year follow-up were included in this report. Subjects were randomized to receive either a "divergent" or "concave" abutment transition profile design for their screw-retained implant-supported restoration. A standardized digital stereotactic photography device that orients the patient in a repeatable position was used to record mid-facial soft tissue dynamics at the time of abutment delivery, and at 1, 3, 6, and 12 months thereafter. One calibrated, blinded examiner measured changes in the apico-coronal dimension of the peri-implant mucosal zenith on clinical photographs using ImageJ software. Intraclass correlation was used to assess intra-rater reliability. Signed Rank, Wilcoxon-Mann-Whitney, and Kruskal-Wallis statistical analyses were performed.

Results: There was a significant increase in mid-facial mucosal height at 12 months in both the concave (mean=0.32mm; p=0.0067) and divergent (mean=0.34mm; p=0.0085) abutment groups. The difference between the two groups was not statistically significant (p=0.71). Tissue phenotype was considered; however, the difference in mid-facial mucosal height at 12 months between subgroups defined as "thick" versus "thin" tissue phenotype was not statistically significant (p>0.50).

Conclusion: A significant gain in the apico-coronal dimension of the mid-facial peri-implant mucosa was observed in both groups with no statistically significant differences between groups at one year post-functional loading. Therefore, it seems that mid-facial abutment morphology does not play a crucial role in the position of the buccal gingival zenith in this subset of our study cohort.

7. Anterior Restoration Longevity among Nursing Facility Residents (30-Year Retrospective Study)

T.S. Ghazal[1], **Daniel J. Caplan**[1], H. Cowen[1]

[1]University of Iowa, Iowa City, IA

Objective: To assess factors influencing anterior dental restoration longevity in the institutionalized elderly.

Methods: Among residents of several nursing facilities in eastern Iowa, all teeth that received at least one restorative procedure were identified, then one tooth per patient was selected at random. Starting with the first restorative procedure for that tooth, all subsequent procedures for that tooth and patient were recorded through the date of that patient's last visit. Kaplan Meier survival curves were generated for anterior restorations from 1985-1999 and 2000-2014 separately, where failures were defined as subsequent restorative codes on the same surface; endodontic procedures; or extraction. Bivariate and multivariable Cox proportional hazards modeling were performed.

Results: There were 521 (mean age=85.6±7.5 years) and 533 (mean age=87.0±7.4 years) subjects who had an anterior tooth selected in the 1985-1999 and 2000-2014 cohorts, respectively. Most of the residents were female (>70%). In multivariable analyses in the 1985-1999 cohort (n=496), lower hazards for restoration failure were reported in females <75 years old, compared to males <75 years old (p=0.016), males>75 years old (p=0.026), and females >75 years old (p=0.030); one-surface compared to three-surface restorations (p<0.001); and restoration placed by faculty/residents compared to predoctoral students (p=0.009). In multivariable analyses in the 2000-2014 cohort (n=521), lower hazards for restoration failure were reported in females <75 years old, compared to males >75 years old (p=0.014) and females >75 years old (p=0.011); residents who paid out of pocket compared to those on Medicaid (p=0.016); composite restorations compared to GIC (p<0.001); restorations placed on the right side compared to left side (p=0.046) and two-surface restorations, compared to one-surface restorations (p=0.004).

Conclusions: Knowing how long restorations last, and what factors affect their longevity, potentially could influence treatment planning and informed consent; improve communication with residents and caregivers; and help develop practice guidelines for restorative care among the institutionalized elderly.

8. Comparison of Surgical and Non-Surgical Orthodontic Treatment Approaches on Occlusal and Cephalometric Outcomes in Patients with Severe Class II Division I Malocclusions

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This study aimed to examine end-of-treatment outcomes of severe Class II Division I malocclusion patients treated with surgical or non-surgical approaches. This study tests the hypotheses that occlusal outcomes (ABO-OGS) at end of treatment will be similar while cephalometric outcomes will differ between these groups. A total of 60 patients were included: 20 of whom underwent surgical correction and 40 of whom did not. The end of treatment ABO-OGS and cephalometric outcomes were compared by Mann-Whitney U tests and multivariable linear regression models. Following adjustment for multiple confounders (age, gender, complexity of case, and skeletal patterns), the final deband score (ABO-OGS) was similar for both groups (23.8 for surgical group versus 22.5 for non-surgical group). Those treated surgically had a significantly larger reduction in ANB angle, 3.4 degrees reduction versus 1.5 degrees reduction in the non-surgical group (p=0.002). The surgical group also showed increased maxillary incisor proclination (p=0.001) compared to candidates treated non-surgically. This might be attributed to retroclination of incisors during treatment selection in the non-surgical group — namely, extraction of premolars to mask the discrepancy. Studies such as this are necessary because they begin to give practitioners a view of not only the outcomes of a single treatment plan, but a comprehensive approach by providing evidence of the over-arching treatment used for successful treatment in both groups.

9. A Sox2-Lef-1 Protein Interaction Inhibits Lef-1 Transcriptional Activity and Wnt Signaling during Odontogenesis

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Tooth development proceeds through a series of steps wherein epithelial and mesenchymal tissue layers cooperate to form a tooth bud, and cells in the tooth bud are organized and differentiated into a mature tooth. Throughout this process, the changes in gene expression that are required for tooth formation are prompted by transcription factors. Lef-1 is a transcription factor and a major effector of WNT signaling, and the loss of Lef-1 expression or an ectopic increase in Lef-1 results in dramatic dental anomalies in mice. The transcriptional mechanisms responsible for maintaining appropriate levels of *Lef-1* expression and downstream targets are not well understood. We show that Sox2, a major regulator of dental stem cells inhibits Lef-1 transcriptional activation. Endogenous Sox2 directly binds to Lef-1 and we have identified specific motifs in the Sox2 and Lef-1 proteins regulating this interaction. By immobilizing different GST-labeled Sox2 domains we show that the HMG domain of Sox2 is required for the Sox2-Lef1 protein interaction. Functionally, Sox2 is capable of disrupting the association of Lef-1 protein with its consensus DNA binding sequence. Taken together, these data suggest a novel mechanism wherein the Sox2 protein functions to negatively regulate the expression of Lef-1 and Lef-1 target genes during odontogenesis. These new mechanisms may also regulate other epithelial organs during development.

10. Significance of Perinatal Oral Health in an American Indian Population

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Purpose: This study aims to investigate possible relationships among *mutans streptococci* (MS) counts, *lactobacillus* (LB) counts, total bacterial counts, demographic characteristics, DMFS, and dietary habits of a population of American Indian women during the perinatal period.

Methods: Pregnant women from a Northern Plains Tribal community were recruited to participate in a longitudinal study of oral health and associated risk factors. A standardized dental examination and a questionnaire were completed for each of the mothers at the initial visit. Whole mouth plaque samples were also collected from the mothers at the initial visit. Samples were spiral plated onto MSKB (Mitis salivarius-Kanamycin-Bacitracin) agar for MS counts and isolation; onto Rogosa agar for LB counts and isolation; and onto blood agar for total bacterial counts. Bivariate analyses to assess covariate relationships with DMFS were conducted using standard chi-square analysis, Kruskal-Wallis tests, and Spearman rank correlations. Covariate effects were further characterized using negative binomial modeling. Analyses were performed using SAS 9. 4 (Cary, NC). A 5% level of significance was specified.

Results: To be determined.

Conclusion: To be determined.

11. Matrix Metalloproteinase Responses of HNSCC and Immune Cell Transwell Co-Cultures

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Head and neck squamous cell carcinoma (HNSCC) is the sixth most common form of cancer by incidence worldwide. Cancer metastasis is associated with an increase in matrix metalloproteinases (MMPs), enzymes that break down basement membrane allowing cancer cells to spread. MMPs play a role in the pathogenesis and metastasis of HNSCC in the tumor microenvironment, but cellular interactions and events leading to their enhanced production are not well understood. The objective of this study was to determine the MMP production of dendritic cells, T-cells, and HNSCC cells in transwell co-cultures compared to these cell types cultured singly or in pairs. Compared to single-cell cultures, the co-culture better represents the tumor microenvironment by including both immune cells and cancer cells. 1-cell, 2-cell, and 3-cell transwell co-cultures were assembled and incubated at 37°C. Two HNSCC cell lines were used. Tissue culture media was collected at 0, 2, 4, 8, 16, 32, and 64 hours. The responses of four MMPs (MMP-1, MMP-2, MMP-7, and MMP-9) were determined through multiplex immunoassays of culture media. A two-way fixed effect ANOVA was fit to log-transformed concentrations of the MMPs and pairwise group comparisons were conducted using Tukey's Honest

Significant Differences test (p<0.05). Cancer cell cultures of both cell lines produced all four MMPs tested. However, differences in MMP production of the 3-cell co-cultures versus HNSCC cells in cultures by themselves became significant over time (e.g., MMP-9; p<0.05; 32hrs). Increased MMP production occurred in the presence of HNSCC cells and immune cells compared to HNSCC cells grown singly. This suggests interactions among HNSCC cells and immune cells can increase MMP production, augmenting the metastatic potential of HNSCC. Studying the MMP responses via co-culture will provide new insight on the roles of MMPs in metastasis of HNSCC and may help us find a treatment to arrest MMP production.

12. Three-Dimensional Printed Composite Scaffolds Enhance *in vivo* Bone Regeneration in Rat Critical-Sized Calvarial Defect

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Defects in oral and craniofacial bone tissues resulting from trauma, congenital abnormalities, or cancer resection are major medical concerns. A plethora of studies have reported considerable shortcomings of current clinical treatments using autografts, allografts and xenografts. Tissue engineering (TE) has emerged as a highly promising alternative to conventional treatment strategies for the repair or replacement of damaged bone. TE applications commonly encompass the use of three-dimensional (3D) scaffolds for the incorporation of cells or biomolecules. Various techniques have been used for the fabrication of 3D scaffolds. Generally, conventional fabrication techniques do not enable the fabrication of complex architectures. However, 3D bioprinting enables the process of a broad range of materials and the fabrication of scaffolds with improved design and complicated 3D microstructures.

Objectives: The purpose of the present study was to design a nontoxic and osteoconductive composite scaffold using 3D bioprinting and to evaluate bone healing in rat critical-sized calvarial defects.

Methods: Polycaprolactone (PCL) was combined with poly(lactic-co-glycolic acid) (PLGA) and Hydroxyapatite particles at a ratio of 45:45:10, fully melted at 110ºC and then stirred until all components were homogeneously mixed. Scaffolds were manufactured using a Regemat V1 3D bioprinter (REGEMAT 3D, Spain) equipped with a fused-deposition modeling (FDM) system. The composite material or PCL alone were loaded into the nozzle chamber, heated to a semi-liquid state and extruded. Printing parameter such as temperature, pressure, and extrusion head speed were optimized in order to maximize print quality.

The morphology of the scaffolds was studied using scanning electron microscopy (SEM) (JEOL 6360 LV, Soquelec, Montreal, QC, Canada) at an accelerating voltage of 30 kV. Before observation, the scaffolds were coated with gold by means of a sputter coater (JFC-1200 Fine Coater, JEOL, Tokyo, Japan). Structural properties Porosity and pore size were determined by mercury intru- sion porosimetry (Poresizer 9320, Micromeritics Instrument Corp., Norcross, GA), which measures the nonswollen ?xed pores. The apparent density and porosity of the Coll/HA/PLCL scaffolds were assessed by measuring their dimensions and mass. The density (q) of each scaffold was calculated as q = m/V, where m is the mass and V is the volume. The porosity of the Coll/HA/PLCL scaffolds was calculated as follows: porosity (%) = 100 (1 - q/qc), where q is the density of the porous scaffold and qc the density of the compact amorphous PLCL assumed to be 1.21 g/cm^3

The ultra-morphology and the surface elemental composition of the scaffolds were assessed using a scanning electron microscopy (SEM) equipped with an energy dispersive detector (EDX) (Hitachi S-4800, Japan). Porosity and pore size were determined by Microcomputed tomography (microCT) (Bruker Skyscan 1272, Belgium).

Printed scaffolds (10x10x2 mm), were sterilized and subsequently loaded with 5×10^5 rat bone marrow MSCs (BMSCs) and cultured in osteogenic medium for various periods. Following each culture period, the proliferation rate, ALP activity and tissue mineralization were analyzed and transcripts of osteogenic markers were quantified using real-time PCR.

Male Sprague Dawley (SD) rats aged 12 weeks were used as animal model of critical-size calvarial defects. Briefly, full-thickness defects measuring 9 x 9 mm were created in the parietal bones with attention paid to preserving the dura mater. The 3D printed scaffolds were then inserted into the defect. After 12 weeks, animals were euthanized, and the bone regeneration was analyzed using microCT and histological observations.

Results: The resulting PCL/PLGA/HA scaffold displayed a high uniform porosity and highly interconnected pores. Surface analyses revealed the presence of HA particles on the surface of the scaffold. Proliferation assay, microscopic observations, and gene analysis showed that BMSCs were able to attach,

proliferate, and differentiate into osteoblasts. Micro-CT and H&E analysis revealed that defects filled with composite scaffolds showed a significant increase in new bone formation compared to the PCL scaffold.

Conclusion: We produced a bioactive and osteoconductive scaffold using 3D bioprinting technology with high osteogenic potential for bone repair. This scaffold may be useful as a patient-specific craniofacial implant for guided bone regeneration in a clinical setting.

13. *In vivo* Inhibition of microRNA (miR) Using a Novel miR Inhibitor System Reveals a Role for miR-17-92 in Palatogenesis

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MicroRNAs (miRs) are short non-coding RNA molecules approximately 22 nucleotides long. miRs bind to complementary targets on the 3' untranslated region (UTR) of messenger RNAs (mRNAs), attenuating mRNA translation via either mRNA strand degradation or sequestration. Since their initial discovery, a multitude of miRs have been implicated in basic developmental and disease processes. Given their redundancy throughout the genome, conventional knockout strategies are difficult to employ when studying miRs. To circumvent this difficulty, we have developed a novel method of miR inhibition, the Plasmid-Based miRNA Inhibition System (PMIS), to allow for the simultaneous knockdown of homologous miRs. Short hairpin structures that flank the anti-sense miR target site on the PMIS inhibitor complex (PMIS-IC) dramatically increase miR inhibition by associating with RNA-induced silencing complex (RISC) factors. The PMIS-IC is composed of native, unmodified nucleic acids and can be stably integrated into the genome. In this study, we employ this strategy to analyze the effects of inhibition of mature miRs in the miR-17-92 cluster. Here we show how the PMIS system can be used to inhibit miRs from the miR-17-92 cluster and associated family members in stable cell lines and transgenic mice. We also show how inhibition of the miR-17-92 cluster can lead to differences in the point of palate formation arrest in mice carrying PMIS-ICs for miR-17-92. These results demonstrate the effectiveness of this novel miR inhibition strategy and indicate a possible role for miR-17-92 in palatogenesis.

14. Mechanical Preparation of Oval-Shaped Root Canals in Mandibular Premolars with the TRUShape 3D Conforming File: A Micro-Computed Tomography Study

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The TRUShape 3D Conforming File (TS), a novel, S-shaped nickel-titanium (NiTi) rotary file, was developed to facilitate mechanical preparation of non-round root canals. The purpose of this study was to evaluate the shaping ability of TS compared to Vortex Blue (VB) when used in non-round, oval-shaped root canals by micro-computed tomography (MCT).

Thirty single-rooted human mandibular premolar teeth with radiographically similar root canal size and curvature were randomly allocated to two groups (n=15), and mechanically prepared with TS or VB. Each tooth was submitted to MCT at 20µm resolution at three time intervals: before shaping, and after shaping to an intermediate apical size #30 and a final apical size #40. Using automated superimposition, 3D data sets were evaluated for root canal volume and treated surface. Matched axial slices in the apical, middle, and coronal root thirds were evaluated for canal transportation expressed as center of mass shift (CMS). Data were statistically analyzed using parametric and non-parametric tests

Root canal volumes increased similarly and significantly overall in the TS and VB groups ($p<0.001$; from an initial volume of 7.5 ± 3.4 mm^3 to an intermediate volume of 8.8 ± 3.0 mm^3 and a final volume of 10.1 ± 2.9 mm^3). Treated canal surface was significantly larger in the TS group at both apical sizes #30 and #40 with $72\pm15\%$ vs. $55\pm23\%$ and $85\pm12\%$ vs. $71\pm20\%$ non-static voxels for TS and VB, respectively ($p<0.05$). Canal transportation was less than 100 µm in all but 5 sections and not significantly different between groups.

This micro-computed tomography study demonstrated the TRUShape 3D Conforming File to be effective in the mechanical preparation of single-rooted premolars with non-round, oval-shaped canals.

15. The Role of Iroquois Homeobox 1 (Irx1) in Root Development

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Iroquois 1 (Irx1) is a homeobox transcription factor that was identified in craniofacial tissues through RNA-sequencing and bioinformatics analyses. Irx1 is expressed in specific dental tissues during development and adult stages. Irx1 is present in the outer enamel epithelium and the stratum intermedium at prenatal stages. The expression of Irx1 is maintained until tooth eruption and at this stage, it appears to play a role in root formation. Heterozygous Irx1 knockout mice show Irx1 expression in the Hertwig Epithelial Root Sheath and in the outer enamel epithelium at post-natal stage p12 in molars. Epithelial rests of Malassez and isolated cells in the inter-radicular cementum are positive for Irx1 expression. The presence of Irx1 is nonexistent in late stages on the root surface. Differences in Irx1 levels can be found in cultured cementoblast and periodontal ligament cells. Cementoblasts have a higher level of Irx1 than periodontal ligament cells. These findings were confirmed by real-time PCR and protein levels. Under mineralization conditions, cementoblasts show a reduction in the level of Irx1 expression. The presence of Irx1 during tooth development is indicative of the implication of this novel transcription factor in tooth formation. Moreover, the positive expression of Irx1 in cementoblasts under non-mineralization conditions and its reduction of expression under-mineralization conditions may suggest it regulates genes involved in root formation and possibly the origin progenitor cells of the cementum

16. Visual Vs. Spectrophotometric Analysis for Bevels in Class IV Restorations

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Objective: The purpose of this study was to determine which type of bevel in a class IV dental composite restoration is the most esthetic and most closely mimics the optical properties of natural tooth structure via clinical and spectrophotometric evaluations. The null hypothesis is that there is no difference between bevels, in regards to what is more esthetic.

Methods: The class IV samples were made via CAD/CAM milling for standardization. There was a negative control (no bevel), a positive control (original tooth), and six different types of bevels. The fractures were restored with a nanofilled dental composite via a template fabricated with a 3D printer. Once completed, the samples were randomized and evaluated visually by 91 people in five groups (faculty, graduate residents, undergraduate dental students, assistants/hygienists and auxillary staff). Evaluators placed the samples in the order they deemed least to most esthetic. After the visual evaluation, the lightness values were measured optically with a spectrophotometer at various points on each sample. One-way ANOVA with the post-hoc Tukey's HSD was conducted to detect the difference in mean rating score among five groups of evaluators and Kendall's W was used to evaluate an agreement among multiple raters.

Results: The groups were ranked from least to most esthetic as follows: No bevel, Short and straight bevel, Short and scalloped bevel, Long and straight bevel, Long and scalloped bevel, Infinite and straight bevel and Infinite and scalloped bevel by the 91 evaluators and Kendall's W was 0.80 (strong agreement). No significant difference in rating scores was found among the five groups of evaluators regarding each type of bevels ($p > 0.05$).

Conclusions: The null hypothesis was rejected; the findings of this study indicated that infinite and scalloped bevel was the most preferred and no bevel was the least preferred via a strong agreement the evaluators.

17. A Comparison of the Hall and Conventional Stainless Steel Crown Techniques in Primary Molars: A Retrospective Study

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Objectives: The purpose of this retrospective study was to assess success rates of stainless steel crowns (SSC) placed on primary molars using the conventional technique involving caries removal and tooth preparation, and the Hall technique, a novel process with no local anesthetic, no caries removal and no tooth preparation. The results of this study will help determine success rates of both techniques over a 20-month period.

Methods: A retrospective analysis was performed using recorded data of patients with primary molars treated with SSCs placed using the Hall technique and the conventional method between 2011-2015 at the Pediatric Dental Clinics of the University of Iowa College of Dentistry. Hall crown cases were matched by tooth and age (+/- 1 year) with cases that had the crowns placed by the conventional technique. Case failure was measured clinically and defined as the need for pulp therapy or extraction following initial crown placement.

Results: Two hundred and fifty-eight Hall crowns were reviewed and clinical outcomes were analyzed, the mean age of the child at treatment was 5.7 years and 62.9% were males. Two hundred and fifty-eight children with matching teeth restored by the conventional technique had a mean age at treatment of 5.8 years and 59.6% were males. At the time of the first follow-up for Hall Crowns at 7.9 months, one crown had failed (99.6% success). Two conventional crowns failed (99.2% success) after 10.4 months. At the second follow up, 93 Hall crown subjects (36.1%) and 180 conventional subjects (69.8%) had returned for follow up treatment at 16.4 months and 20.8 months, respectively. At the second follow-up visit, one additional crown placed with the Hall technique presented with clinical failure (98.9% success), while two of the conventionally placed crowns had a similar fate (98.9% success).

Conclusion: The findings of this study provide significant information regarding the outcomes of primary molars treated with stainless steel crowns and show that the success of the Hall technique is similar to the conventional method. In addition, these results validate prospective investigation with greater specificity and extended follow-up in the future. Further analysis is ongoing and results will be reported.

18. Absolute Tooth Length and Predicting the Timing of Dental Eruption

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Objectives: It is important for orthodontists to be able to accurately assess dental development when devising treatment plans. Current methods which rely on descriptive categories (e.g., "1/4 root complete") are difficult to assess in a growing patient, leading to the need for a more direct quantitative method. There is a dearth of information about the relationship between absolute (e.g., in mm) tooth length and eruption. What prior work has been done assessing the relationship between absolute tooth length and tooth development has used cross-sectional samples, often from archaeological contexts. There are currently two published methods for predicting age based upon absolute dental measurements of the permanent dentition: Liversidge and Molleson (1999), and Smith and Buschang (2010).

Methods: We used the Iowa Growth Study to test the null hypothesis that the relationship between tooth length and age is consistent across development. Total tooth length and root length were measured for lower canines and first premolars. Measurements were taken at age 8, at the age of eruption of each tooth of interest, and at age 14.

Results: In our sample, we found that tooth root length at age 8 was predictive of root length at age 14 ($p=0.03$; rho=0.199), and that canine eruption age was highly predictive of premolar eruption age ($p<0.001$; rho=0.814). We also found that absolute tooth root length at age 8 was strongly predictive of age of tooth eruption in both canines ($p<0.001$; rho=-0.600) and first premolars ($p<0.001$; rho=-0.417).

Conclusions: These results indicate root length may be a useful predictor of timing of dental eruption. Future work will use the measurements from this study to attempt to validate both the Liversidge and Molleson (1999) method and the Smith and Buschang (2010) method.

19. Associations Between Beverage Characteristics and Caries Experience in American Indian Children

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Objective: Sugar sweetened beverages are known to increase caries risk. However, how the relative sugar content, pH, and titratable acidity of beverages might influence caries experience is unknown. Our aim was to identify the physiochemical properties of commonly consumed beverages and their associations with the caries experience of American-Indian (AI) children.

Methods: Data were collected as part of a longitudinal investigation of risk factors for caries in AI children. Caries-free children (n=46) were compared to children with severe caries (n=43) at 36 months. Individual beverage intake information (i.e., type, brand, flavor, quantity) was collected from 24-hour recalls completed at 22 months. Beverages were purchased, sugar content was identified from product labels, and pHs and titratable acidities (TA) were measured. Beverages were grouped by sugar content (sugar-free, low, medium, high), pH (low, medium, high), and TA (low, medium, high); the percent intake for sugar content, pH and TA groupings were then identified for each child. The Wilcoxon rank-sum test was used to identify percent differences in intake of sugar, pH and TA between caries groups.

Results: Mean dmfs of severe caries children was 43.5±11.6. The percent intake of sugar-free beverage consumption was higher in caries free (28.9±28.2%) than in the severe caries (16.6±21.9%; p=0.0230) children; percent intakes of other sugar groups did not differ between caries-free and severe caries children. The percent intake of low, medium and high TA and pH beverages did not differ between caries-free and severe caries children.

Conclusion: This data suggest that higher percent intakes of sugar-free beverages might contribute to a lower caries experience. There does not appear to be a relationship between caries experience and the TA or pH of beverages.

20. Characterization of a Polydopamine Coating on Dentin

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Background: Mussels secrete a bioadhesive substance, mainly consisting of 3,4-dihydroxy-L-phenylalanine (L-DOPA). Polydopamine (PDA) is a derivative of L-DOPA and has shown promise as a remineralization agent for dentin. Based on our previous report, we found that modifying dentin with PDA decreased the shear bond of strength (SBS) of glass ionomer materials, which was opposite of what we hypothesized. We anticipated an increase in SBS due increased remineralization of dentin coated with PDA, indicating an increase of hydroxyapatite. Hydroxyapatite (HA) is composed of calcium, phosphate, and hydrogen. Therefore, we hypothesized that modifying dentin with PDA would increase the HA content of dentin. Our objective was to measure the effect of modifying dentin from extracted teeth with polydopamine by using scanning electron microcopy (SEM) and x-ray photoelectron spectroscopy (XPS).

Methods: Coronal dentin slices were cut from extracted third molars and polished using 600 grit SiC paper. For the experimental group, dentin slices were coated with polydopamine. For the control group, the dentin specimens were left uncoated. Groups were subjected to SEM and XPS analysis.

Results: The surface of the coated and uncoated dentin specimens had different surface morphology and composition. The SEM images showed more rope-like structures with the PDA coated dentin (n=3) compared to the image of the smear layer on the uncoated dentin (n=3). Under XPS analysis, there were less calcium, phosphorous, and oxygen on the coated surfaces (n=4) compared to the uncoated surfaces (n=1). This result provides the mechanism of why there is a decrease of SBS as we previously reported.

Conclusions: Modifying the dentin substrate with a polydopamine coating decreased the amount of hydroxyapatite on the surface, which negatively affects the shear bond strength of glass ionomer and resin-modified glass ionomer to the substrate.

21. Comparing Light Propagation between Dental Tissues and Resin-Based Composites

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Objective: The purpose of this study was to compare the light propagation (absorption (A), transmittance (T), and attenuation coefficient (K)) between natural dental tissues and four different resin-based composites (RBC): Microfilled, Micro-Hybrid, Nanofilled and Supra-nanofilled using a two layers incremental technique analyzed by a blue LASER with a spectrophotometer.

Methods: Four unerupted, non-carious, non-restored, non-identifiable, IRB-exempt extracted teeth (shade B1) were selected, randomized, mounted and sectioned into ten 2.25mm x 2.25mm samples (control group). Using the Estelite Omega Custom Shade Guide, 40 (n=10/per group) double layered (dentin/enamel) samples of Microfilled, Micro-Hybrid, Nanofilled and Supra-nanofilled were created. Averages of RBC sample thickness were taken and the natural dental tissue samples were adjusted to match this thickness of dentin and enamel. The samples were placed at the center of the rotary stage of the spectrophotometer at 0° angle and irradiated from occlusal to cervical with the blue LASER beam. A calibrated voltmeter was used to measure the light output signals (V0=initial and V1=final) and from these measurements, then A, T and K were calculated. One calibrated operator performed all readings. One-way ANOVA, followed by the post-hoc Tukey's HSD test, was conducted to detect the difference in A, T, and K between natural dental tissues and four types of RBC (alpha=0.05).

Results: There was a significant difference in A, T, and K between the natural dental tissues (A=0.128±0.032; T=0.747±0.053; K=0.034±0.009) and Nanofilled RBC (A=0.054±0.026; T=0.884±0.052; K=0.015±0.007) (p<0.0001); while no significant difference in A, T and K was noted between the natural dental tissues and Microfilled, Micro-Hybrid, and Supra-nanofilled RBC (p>0.05 for all instances).

Conclusions: Inside the range of this study, except for Nanofilled RBC, it can be concluded that there is a similar pattern of light output signals when comparing Microfilled, Micro-Hybrid, and Supra-nanofilled RBC to the natural tooth tissues.

22. Competitiveness of Mutans Streptococci Species Isolated from American Indians

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Objectives: Severe-early childhood caries (SECC) is a highly prevalent infectious disease in American Indian (AI) children. *Streptococcus mutans* (SM) and *Streptococcus sobrinus* (SS) are key etiological agents of dental caries. Studies suggest that SS could be more cariogenic than SM, however, its prevalence is usually low in the oral cavity. The objective of this project was to compare competiveness between SM and SS strains isolated from a Northern Plains American Indian population with high levels of SS.

Methods: Unique genotypes of SM (n=23) and SS (n=9) isolated from whole mouth plaque samples collected from AI subjects were selected for testing. Each genotype was tested for inhibition of, and susceptibility to, each genotype from the other species. Species were plated side by side on BHI agar 24 hours apart, incubated for 48 hours, and scored for inhibition and susceptibility based on an established scale. Spearman rank correlation and Shapiro-Wilks' tests were performed comparing the inhibition, prevalence, and susceptibility profiles.

Results: There was a positive correlation between Inhibition Profile and Susceptibility Profile (p=0.0304) for SS genotypes, but no statistically significant correlations between Inhibition or Susceptibility profiles and SS Prevalence. There was, however, a strong negative correlation between Prevalence of SS genotypes and Percent Recovered with SM (p=0.0046).

Conclusions: More prevalent SS genotypes were less likely to be recovered together with SM. However, the Inhibition and Susceptibility Profiles of the SS genotypes did not explain this observation within the power of this study. SS genotypes that were most sensitive to SM genotypes also showed the most inhibition towards SM genotypes, perhaps demonstrating the importance of the order of establishment within plaque. Analysis of additional SS genotypes and exploration of the mechanism of inhibition will help us understand the relationship between SM and SS in this population and the higher prevalence of SS.

23. Deciduous Teeth Eruption in Premature vs. Full-Term WIC-Enrolled Children

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Purpose: Investigate the relationship between premature birth and emergence of deciduous teeth in a sample of children aged 0-45 months. Additional goal was to determine factors that may affect the eruption timing in premature children compared to full-term born controls.

Methods: This is a cross sectional study approved by the Institutional Review Board of the University of Iowa (ID#: 201412750). Data were collected from records of children attending the University of Iowa's Infant Oral Health Program (IOHP) (1998-2009). Data included child and maternal ethnicity, child's age, gender, medical and dental history, and clinical examination findings (including teeth present). Possible associations between deciduous teeth eruption and factors such as age, sex and ethnicity were assessed using Kruskal-Wallis tests, Wilcoxon-Mann-Whitney procedure using the Holm-Bonferroni method with an overall 0.05 significance level. Violin plots will be used to compare six landmarks including: eruption of the first primary tooth, eruption of all 20 teeth in the primary dentition, eruption of the four maxillary incisors, eruption of the 8 anterior teeth, eruption of the 8 posterior teeth and eruption of the 16 anterior and posterior teeth (exclusive of canines). Multivariable analysis will utilize negative binomial modeling.

Results: Our sample size was 1032 records of children attending IOHP located at the Johnson County Department of Public Health Women, Infants and Children (WIC) Clinic from September 1998 to November 2009. Statistical analyses are in progress.

24. Descriptive Analysis of Patient and Practitioner Trends at the Dr. Rhys B. Jones Dental Health Center

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Introduction: Federally Qualified Health Centers (FQHCs), Community Health Centers (CHCs), and local free clinics serve important roles in the U.S. healthcare system, providing services to individuals who could not otherwise afford them. The Dr. Rhys B. Jones Dental Health Center (DHC) at the Cedar Rapids Unity Point — St. Luke's Hospital provides need-based dental care to residents in Cedar Rapids and surrounding counties. This study investigated basic descriptive and analytical questions about the DHC population and their care.

Methods: Excel and SAS were used to describe DHC patient demographics and billed clinical treatments.

Results: Payer trends from 2011-15 showed Medicaid (Title XIX) consistently covered >79% of treatments, increasing to 87% (2015). Mean/median ages at first visit declined steadily from 1997-2015 (9.8 to 5.8 and 10 to 4, respectively). New patient trends show steady growth from 2011-2015 (~800 to ~1400. The number of posterior composites placed declined substantially (613 in 2011 to 206 in 2015), while posterior amalgams (175 in 2011 to 457 in 2015) and stainless steel crowns (340 in 2011 to 880 in 2015) increased considerably over the same period of time. Total numbers of billed treatments also showed steady growth from 2011-2015.

Conclusion: This descriptive analysis has shown changes in patient demographics, as well as changing treatment trends. Changing patient demographics are consistent with increased outreach efforts and emphasis on treating underserved children at the DHC. Additional investigation is needed to determine the main driving forces affecting patient demographics and treatment preferences among clinicians at the DHC.

25. Development of a Survey to Assess Diet-Related Oral Health Knowledge

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Objectives: Our purpose is to develop a survey to identify patients' understanding of diet-related oral health information. The patient would complete the survey; the clinician would use the responses to individualize patient diet-related oral health education and support dietary recommendations following their oral risk assessment.

Methods: Five content areas were identified, and 2-3 questions/content area were designed based on the literature. Initial questions were modified from existing oral health and/or nutrition literacy instruments. The questions and formatting were refined following clinician input. The survey was sent to 5 dental nutritionists, and their feedback was incorporated. The survey was piloted with peers and a representative clinic population.

Results: The survey contains 12 questions covering 6 content areas: sugars, processed foods, meal patterns, oral and systemic disease, nutrition information sources and food barriers. The rationale and desired knowledge outcome are identified for each question. An expert panel has evaluated face and content validity. An example question: "Look at the beverages listed below. For each beverage, does drinking it increase your chances of getting cavities?" The knowledge outcomes identified for this question include: 1) sugars (particularly added sugars) increase caries risk and 2) which beverages contain added sugars. There are multiple educational points identified from this question that the clinician can use for patient education during dietary counseling.

Conclusions: This tool is ready to be piloted within the patient population. The tool will be refined throughout the piloting process and reliability will be identified through repeat test administration.

26. Genotypic Diversity of *Streptococcus sobrinus* in American Indian Mother-Child Pairs

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Objectives: American Indian children suffer from high rates of severe early childhood caries (S-ECC). The primary etiological agents of S-ECC are *Streptococcus mutans* (SM) and *Streptococcus sobrinus* (SS). Although SM is more commonly associated with caries, SS is often associated with more severe caries. The objective of this project was to expand upon a growing genotype library of SS isolates from 40 mother-child pairs in a community of Northern Plains American Indians in order to reveal the transmission and colonization patterns of SS within this high-risk population.

Methods: Plaque samples were collected from children and their mothers from the time of the child's birth to 36 months of age. Samples were cultured on MSKB selective agar. SS isolates (identified by PCR) were genotyped using AP-PCR. Gel images were analyzed and compared with GelCompar®IIv6.5 software. Exact Wilcoxon rank sum tests were used to compare the distribution of dmfs/DMFS scores between subgroups based upon presence/absence of SM and SS.

Results: Preliminary data from 34 families show 91.18% of children shared at least one SS genotype with their mother. SS positive individuals hosted a range of 1-3 SS genotypes with families exhibiting a spectrum of 1-4 genotypes. The most common genotype was found in 53% of individuals. Children harboring both SM and SS exhibited significantly higher dmfs scores than children harboring only SM. Similarly, children colonized by SS presented with significantly higher dmfs scores than children not colonized by SS.

Conclusions: Our data continue to show SS genotype commonalities exist both within and across families in our sample population. This supports our hypothesis that SS exhibits some vertical transmission from mother to child. These data also suggest co-colonization with both SM and SS during childhood results in higher caries experience.

27. Iowa Nursing Facility Oral Hygiene Intervention: A Pilot Study

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Background: Multiple chronic conditions are common among nursing facility (NF) residents, and multiple drugs are used to manage these conditions. It is of paramount importance for the dental professional to be aware of common medical conditions and medications among this population, as they can impact dental diseases, conditions (xerostomia is an oral condition markedly affected) and treatment outcomes. This study aimed to investigate co-morbidities, medications and xerostomia among Iowa NF residents.

Methods: This study presented baseline data from individuals residing at Iowa NF who were recruited to be part of a 6-month pilot clinical trial. From a total of 37 nursing facilities within a 75-minute radius of Iowa City that were contacted, eight agreed to participate. From among the 289 residents of these eight facilities, 81 were successfully recruited and enrolled. NF medical records were reviewed for demographic and health history variables. Missing information was provided by directors of nursing. Xerostomia was self-reported. Data were entered electronically and profiled using standard descriptive methods.

Results: Participants had a mean age of 82.1±13 years, 100% were white, 60.5% were females, 45.7% were paying NF privately, and 25.9% were insured through Medicaid. Mean BMI was 27.8 (±7.4). The mean number of co-morbidities per participant was 9.8 (±5.3); the most prevalent co-morbidities were hypertension (72.8%), unspecified dementia (49.4%), depressive episodes (44.4%), gastroesophageal reflux disease (34.6%), constipation (32.1%) and diabetes (25.9%). The mean number of medications per participant was 12.3 (± 5.4); the most used medications were acetaminophen (85.2%), acetylsalicylic acid (45.7%), magnesium hydroxide (45.7%), polyethylene glycol (43.2%), docusate (27.2%), furosemide (27.2%) and omeprazole (27.2%). Xerostomia was reported by 30.9%.

Conclusions: Iowa NF residents presented a high number of co-morbidities and prescribed medications, many of which could have a significant impact on dental disease and treatment. Close to one third of the sample reported xerostomia.

28. Morphological Integration of the Nasal Region

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Objectives: Based on functional and developmental parameters, the nasal complex can be divided into three regions: the superior nasal cavity, inferior nasal cavity, and external nasal region. While researchers have detailed the morphological relationship between these regions and other aspects of the craniofacial skeleton, comparatively little is known regarding the morphological relationship among the different regions of the nasal complex. Ultimately, this is necessary for determining if the nasal complex consists of a single functionally and/or developmentally integrated structure, or whether it can be better understood as a series of relatively modularized (i.e., independent) units. Given the functional interaction among the different nasal regions during respiration and air conditioning, it is possible that these different regions exhibit a high degree of morphological integration. Despite the potential integrative effects of respiratory function, the different nasal regions are nevertheless developmentally distinct, and it is therefore possible that they exhibit a relatively high degree of modularity. Using geometric morphometric techniques, we tested the null hypothesis that the individual regions within the nasal complex are morphologically independent.

Methods: We collected k=44 3D coordinate internal and external nasal landmarks from CT scans of n=63 subjects. Individual landmark configurations were superimposed using Procrustes analysis. We tested for significant correlations between nasal regions using two-block partial least squares analysis. The strength of covariation was assessed using RV coefficient values relative to distributions of values calculated for randomly permuted landmark blocks.

Results: In all comparisons, the covariation between different landmark sets was statistically significant (P<0.05). However, the RV coefficients from the landmark sets were low relative to the RV coefficients derived from random permutations.

Conclusions: Although the individual nasal regions are functionally related and significantly covary in their morphology, our results indicate that the nasal complex consists of multiple relatively modularized units.

29. Oral Health Instruction and Practices among Iowa Family Physicians/ Pediatricians

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Objectives: Medical professionals serve more 0-to-36-month-old children when compared to dental professionals. However, lack of knowledge is one of the most significant barriers for medical professionals to provide oral-health related services for the prevention of early childhood caries (ECC). The objective of this study was to determine if Iowa Family Physicians and Pediatricians have ever received any instruction on topics related to oral/ dental health during medical school, residency, fellowship, and/or continuing education courses. An additional objective was to investigate the impact that reported instructions during medical training had on oral-health knowledge, perceived comfort level, and practices among these health professionals.

Methods: A 17-item survey was mailed to all licensed family physicians (n=1648) and pediatricians (n=465) 75 years old and younger in the state of Iowa. Bivariate and logistic regression analyses were used to analyze the data (alpha=0.1).

Results: The overall response rate was 28% (n=364). Mean age of participants was 48.8(SD=11.6) years. 80.8% reported receiving oral/dental health instructions. On average, participants saw 78.1(SD=36.8) patients a week with 19.7(SD=18.8) between 0-36 months-old. Bivariate analysis indicated that participants who reported receiving instructions were more likely to believe brushing with fluoride toothpaste prevents cavities (p=0.0488) and consider routinely applying fluoride varnish (p=0.0261). Moreover, they were more likely to feel comfortable examining teeth for caries (p=0.0003), identifying caries (p=0.0035) and oral pathology (p=0.0044), deciding if a child needs a dental referral (p=0.0705), and lifting the child's lip to check for early signs of ECC 75-100% of the time (p=0.0809). Logistic regression analysis showed that participants who reported receiving instructions were more likely to believe cavities in young children start with white-spots (OR=1.78; p=0.0457) and feel comfortable evaluating caries-risk factors for tooth decay (OR=2.68; p=0.0011).

Conclusions: Reported oral/dental health instructions during medical training was positively related to physicians' knowledge, comfort, and practices regarding important ECC-preventive oral-health care.

30. Outside Referral Patterns to the Pediatric Dental Clinic

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Objectives: The literature is limited regarding the information related to referral patterns to pediatric dental clinics. Therefore, the main objective of this study was to determine the characteristics of both referring dentists and patients being referred to the University of Iowa Pediatric Dental Clinics (UIPDC) in an effort to understand and improve referral mechanisms.

Methods: Data were collected from 329 charts of children referred to the UIPDC from July 1, 2015 to May 31, 2016. Patient demographic information was obtained including age, number of teeth with decay, and presence of any special health care needs. Information regarding the referring providers included type of provider (general dentists vs. pediatric dentists), practice type (health center, private practice, or corporate practice), and location of the practice. Statistical analysis consisted of descriptive statistics and bivariate analysis (alpha=0.10).

Results: The mean age of patient referrals was 6.8 years (SD=3.1; range=1-16) and 70.9% had Medicaid. Sixty-three percent (n=204) of children were referred by general dentists. Those in need of endodontic treatment (p=0.0583) and extensive comprehensive dental care were more likely referred by general dentists (p=0.0064). Patients who were referred due to their young age and behavioral problems (p=0.0416), intellectual disability (p=0.0817), and need for treatment under conscious sedation (p=0.0001) were more likely to be referred by pediatric dentists compared to their counterparts. No significant association was found between reason for referral and type of payment/patient age (p=>0.05 in each instance).

Conclusion: Important referral differences were found between pediatric dentists and general dentists. It is hoped that these findings will improve the referral mechanisms for patient care.

31. Oxidation of Blue Dye with Hydrogen Peroxide as a Function of pH

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Objectives: To evaluate the effects of pH on oxidation rate of blue food dye (BD) on exposure to hydrogen peroxide at various pHs by measuring absorbance over time.

Methods: Time course reaction of 0.01 ml of dye (Brilliant Blue FCF, 0.01 M) and hydrogen peroxide (HP, 0.01 M) with 0.05 ml of various pHs (4, 5, 6, 7, 8, 9, 10, 1M) buffers were evaluated. The absorbance of seven different mixture aliquots at time intervals of 0-, 10-, 20-, 30-, 45- and 60-minute from the beginning of the reaction were analyzed using a spectrophotometer (Power Wave X-1) on six samples of each reaction at peak wavelength of 630 nm. Possible end products were observed from the evaporated reaction mixture in the pH 8 buffer solution after 24-hour reaction. One-way ANOVA, followed by the post-hoc Tukey's HSD test, was conducted to detect the difference in absorbance values among seven pH levels at each time point. Correlation between pH and absorbance values under different conditions were also evaluated using Pearson correlation test or Spearman rank correlation test.

Results: The effect of pH on absorbance (result of reaction progress) was significant at all time points over a one-hour reaction among the seven pH values ($p<0.0001$ in each instant). The greatest significant decrease in absorbance was observed at pH 8 for every respective time point. Significant correlation between pH and absorbance values at 20 minutes was noted ($r=-0.79$, $p=0.0362$). This suggests that the greatest rate of oxidation occurs at 20 minutes after beginning of the reaction which implies the highest amount of breakdown products formed. When BD and HP are reacted at pH, the end byproducts formed were volatile.

Conclusion: BD on exposure to HP is pH-dependent, with pH 8 showing the greatest significant change.

32. Parental Language Barriers and Oral Health Behaviors among WIC Children

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Objectives: Many studies have examined the relationship between children's caries rate among different ethnic populations. However, few studies have examined the impact of parental language barrier on children's caries rates and risk factors. The main objective of this study is to determine if there is a relationship between parental language barrier and early childhood caries (ECC) risk factors and experiences.

Methods: Data were collected from 576 charts of children aged 12-48 months attending the University of Iowa's Infant Oral Health Program. Caries assessments were recorded using the d1d2-3 caries scoring criteria. Caries-risk factors data included socio-demographic factors, dietary/oral hygiene habits, presence of visible plaque, perceived parental language barrier, and ECC background awareness. Statistical analysis consisted of descriptive statistics and bivariate analyses (alpha=0.05).

Results: About 52% of the children were female with a mean age of 24.6 ± 10.2 months. Twenty-seven percent of parents were reported to have a language barrier. Of the 576 subjects, 85% had never been to the dentist and 33% of children had parents with low dental health literacy. Bivariate analysis indicated that children whose parents had a language barrier were more likely to be Hispanic or White ($p<0.0001$), breastfed to sleep and throughout the night ($p<0.0001$), co-share the bed with the mother ($p=0.0006$), have visible plaque ($p=0.0048$), be categorized as high-caries risk ($p=0.0091$), as well as have parents with higher education ($p=0.0223$) and low dental heath literacy ($p=0.0002$). Conversely, their counterparts were more likely to use fluoride toothpaste ($p=0.0443$) and have parents with previous awareness of ECC ($p=0.0047$).

Conclusions: Although children's caries experience was not statistically significant among parents with a language barrier, several risk factors that may place children at a higher risk for developing ECC were identified.

33. Preliminary Validation of a European Instrument to Measure Clinical Learning Environments for Dental Students (DECLEI) in an American Dental School

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This presentation aims: 1) to present preliminary data about validation for DECLEI in an American dental school, thus providing guidance for a definitive validation study, and 2) to present DECLEI response distribution, thus providing basic understanding of Iowa dental students' perceptions of their clinical learning environment. A panel of five UI faculty assessed DECELI's items relevance and content validity using the content validity index (CVI). DECLEI was then distributed to 144 students (D3 n=74 and D4 n=70). Principal component analysis with an orthogonal (Varimax) rotation was used to assess internal structure of the measure. Internal consistency reliability was assessed using Cronbach's α coefficient and corrected item-total correlations. Descriptive statistics was used to present DECLEI results. CVI was ≥0.80 for most items, except for 4 items which were re-worded to achieve consensus. From the initial 24 items, principal component analysis allowed only 18 items grouped in five domains related to student/faculty interaction, equipment and patient issues, didactic/clinical components interaction, negative perceptions and self-assessment. The Cronbach's α coefficient for the 18-item DECLEI was 0.80. The D3 class averaged a 24-Item DECLEI score of 72.70 (±9.14), D4 class averaged 70.9 (±6.66), and combined D3 and D4 classes averaged 71.78 (± 8.11). For the 18-item DECLEI final average scores were 69.49 (± 10.56), 69.06 (± 7.25), 69.19 (± 9.16), respectively. The scores for each individual class and the combination of the D3 and D4 classes categorized these students as having "Good" clinical education experiences for both 18- and 24-item DECLEI. Data presented here showed the DECLEI has the potential to be used as a reliable instrument to measure clinical learning environment for undergraduate American dental students. Preliminary data showed that Iowa students perceived their clinical education experience as being good.

34. Selective Toxicity of Oral Therapeutics against Oral Streptococci *in vitro*

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Objective: Certain bacteria commonly present in oral plaque, in particular *S. mutans*, have been linked to an increased risk of dental caries. Treatment strategies that target such cariogenic strains may have the potential to disrupt the dental decay process and may encompass the greatest capacity for long-term reduction of caries risk. This study sought to investigate the selective toxicity of chlorhexidine (CHX), povidone iodine (PI), and silver nitrate (SN) against five different oral streptococci commonly found in dental plaque.

Methods: Each therapeutic was tested at 0.1% concentration against *S. mutans*, *S. oralis*, *S. sanguinis*, *S. cristatus*, and *S. mitis*, when grown individually or in pairs, as biofilms in 24-well plates.

Results: *S. mitis* was the most sensitive to these antibiotic agents while *S. mutans* and *S. sanguinis* were the least sensitive. SN was significantly more effective at reducing viable counts of *S. mutans* (2.27 log reduction) than CHX (0.11 log reduction) ($p<.05$). PI (0.86 log reduction) was not as effective as SN but more effective than CHX but these differences were not significant. In dual species cultures, the trend was for *S. sanguinis* to be more resistant to SN and more susceptible to PI than either *S. cristatus* or *S. mutans* though the differences were not statistically significant.

Conclusion: The results of this study suggest that SN is more effective at reducing counts of *S. mutans* than PI or CHX, but that *S. mutans* is among the more resistant oral streptococcal species to oral hygiene agents. Since *S. sanguinis* is associated with healthy oral microbiomes while *S. mutans* is associated with increased caries risk, SN could be the better oral therapeutic choice for long-term improvement in the oral microbiome.

35. Systematic Review of Factors Associated with Conventional Complete Denture Dissatisfaction and Intolerance

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This study reports on preliminary findings from a systematic review of the literature that is being performed to identify factors leading to patient dissatisfaction with denture treatment and denture intolerance. This review follows PRISMA guidelines. A preliminary comprehensive search of the biomedical literature was performed by a librarian using PubMed in order to identify the existing literature and improve search criteria, yielding 4,552 citations. Following this scoping search, new Mesh terms were developed, and Cochrane and PubMed were then searched for systematic reviews resulting in no identical systematic reviews. New Mesh terms were used to refine the initial PICO question, which led to a simplified search criteria. The search was then expanded to other databases (PubMed, CINAHL, EMBASE, PsychINFO, SCOPUS, LILACS, and Web of Science). No language requirement was placed on this search. Grey literature search have included New York Academy of Medicine Library, Google, and OpenGrey. The refined search initially yielded 3,257 citations, and then duplicates were removed, resulting in 1,357 citations. Inclusion and exclusion criteria were then applied: all articles not involving conventional complete dentures and patient satisfaction/dissatisfaction or denture intolerance in the title or abstract, studies involving non-human subjects, as well as literature reviews and opinion pieces were excluded. It resulted in a final number of 392 citations. From these citations, 6 were from 1961-1969 time span, 13 from 1970-1979, 45 from 1980-1989, 64 from 1990-1999, 106 from 2000-2009 and 158 from 2010-2017, showing the growing interest in patient centered outcomes. Future directions for this work will include verification of remaining 433 citations (including 39 grey literature citations) by a second investigator, replication of the selection process, and resolving discrepancies within the group. Following this, further analysis of remaining citations will be performed and data will be presented for abstraction and meta-analysis.

36. Testing the Impact of Dental Probiotics on Oral Malodor

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Sulfur producing bacteria on the tongue cause oral malodor (OM). Tongue scraping and dental probiotics are means of reducing the insult. However, there have been limited studies showing the relationship between probiotics and tongue scraping as it relates to OM. The objective is to determine if dental probiotics provide additional benefit to tongue scraping in reducing OM.

Methods: Twenty-one people were assigned to either a 'no tongue hygiene' control (group A, n=6), a 'tongue scraping+placebo mint' regimen (group B, n=8), or a 'tongue scraping+probiotics' regimen (group C, n=7) for 30 days. There was a run-in period of 7 days before the trial where all participants refrained from tongue hygiene. Pre-trial and post-trial measurements were made using a Halimeter to detect sulfur compounds in breath, and microbiological counts were obtained by plating a tongue swab on blood agar and on oral-hydrogen-sulfide-organism-carbohydrate (OHO-C) agar, which changes color to indicate sulfur producing colonies. The bacteria were cultured anaerobically for 48h at 37ºC.

Results: There was a statistically significant reduction in breath sulfur only in group C (p=0.016). Total bacterial counts dropped in groups B and C but the differences did not reach statistical significance. There was a trend with 5/7 participants in group C showing a reduction in sulfur producing bacteria measured on OHO-C, whereas only 4/8 in group B and 2/6 in group A showed reductions.

Conclusions: Adding oral probiotics to an oral hygiene regimen of tongue scraping significantly reduced OM when measured with a Halimeter. The microbiological basis for this reduction remains uncertain, but may have been due to replacement of sulfur producing bacteria on the tongue by the probiotic strain.

37. Feasibility and Application of ASA 24 in Dental Nutrition Research

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Background: The ASA24 is an automated 24 hour recall tool developed by the National Cancer Institute for epidemiological research. The tool is free to researchers. Use of the tool to collect dietary data in College of Dentistry (COD) dietary studies could significantly improve the quality and consistency of dietary research within the College.

Objective: 1) To determine the feasibility of using the ASA24 to quantify nutrient intakes and caries risk variables and 2) To compare nutrient profiles of dietary records analyzed using ASA24 to nutrient profiles analyzed using Nutritionist Pro®.

Methods: A representative sample (n=25/age) of twenty-four hour dietary recalls collected at 8, 16, and 36 months previously analyzed by Nutritionist Pro® were entered into the ASA 24 data system. Nutrient intakes were compared between programs using SAS 9.4 (Cary, NC); median differences were compared using the signed-rank test.

Results: In general, statistically significant differences in median intakes were noted between programs at each age. At 8 months, 14 nutrients had significant differences; at 16 months, 9 nutrients had significant differences; and at 36 months, 13 nutrients had significant differences (p<0.05). Furthermore, most differences exceeded an acceptable difference of 5%. Differences ranged from 0.2% for thiamin at 36 months to 185% for vitamin A at 8 months.

Conclusion: The ASA24 is user friendly and nutrient analyses is appropriate for COD dietary research. However, the discrepancies between nutrient intakes of 24 hour recalls analyzed by Nutritionist Pro® and ASA24 dietary data collection resources are extremely high and the programs can not be used interchangeably to analyze dietary records within a study.

38. Validation of a New Scale to Assess Ageism among Dental Students

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Background: Effective health care for the elderly is complicated by multimorbidity and ageism. Ageism is very prevalent, and refers to age discrimination, or the prejudice by one group toward other age groups. This work reported on a preliminary validation study of a novel scale for assessing ageism among dental students. An appropriate scale for dental students can provide information that helps addressing potential biases or attitudes when treating an older population. This data may help when creating or modifying existing courses that address these biases.

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 applied to a sample of 144 Iowa dental students (74 D3s and 70 D4s). All five panel 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 α loading < 0.40, loading on more than one factors or those unexpectedly grouped in another factor were thoroughly examined.

Results: The 27-item scale only had 4 items and a single factor remaining that explained more of the overall variance and had a substantially higher reliability value than any other solution/number of factors. The four items and respective factor loadings are "Elderly people do not take good care of their teeth" (.743), "Elderly patients do not usually comply with dental advice" (.846), "Dental treatment of elderly patients is too time-consuming" (.730), "It is too costly to provide out of office dental care to homebound elderly patients" (.734). The Cronbach's alpha for this single factor was .75.

Conclusions: This preliminary analysis pointed to four items achieving high reliability, providing important guidance for a future definitive validation study with a larger sample.

39. Differences between Communities with One or No General Dentist

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Objective: This study reviews the influence of community level variables in determining whether there was either one or no general dentist in Iowa communities greater than 1,000 population.

Methods: Using the 2014 Iowa Dentist Tracking System, each active dentist was geocoded to their primary practice location. Bivariate statistics explored relationships between communities with either 0 or 1 dentists and the following predictor variables: population; population density; household income; educational level; median age; rurality; presence of a public elementary school; and time (minutes) to next nearest dentist. A multivariable logistic regression model was then built and interactions between predictor variables explored.

Results: 283 of Iowa's 947 incorporated communities had a population in excess of 1,000 population, with 60 having one general dentist and 82 none. Differences existed between communities with 0 or 1 dentists (n=142) based on population size (p=0.0003), population density (p=0.0182), and rurality (p=0.0417). Communities were 1.134 times as likely to have a single dentist with each additional 100 people in the community. However, there was an interaction between rurality and percentage of population with at least a bachelor's degree. For each percent with a bachelor's degree, the community was 1.19 times as likely to have a single dentist.

Conclusion: Although population impacts whether a community has a single dentist, it may not be the sole determinant in predicting practice location.

40. Hospital Emergency Department Visits by Ambulance for Tooth Pain

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Objective: Information on the use of an ambulance to convey patients complaining of tooth pain (TP) to emergency departments is scanty in the United States. The purpose of this study was to examine the prevalence of ambulance use for TP visits to emergency departments (ED) and factors associated with such visits.

Methods: Data from the National Hospital Ambulatory Medical Care survey (NHAMCS) for 2003 to 2012 was analyzed to identify the estimated prevalence of ED visits for tooth pain, and among those visits, the number who were conveyed by ambulance. Descriptive statistics were obtained and multivariate logistic regression used to determine the odds of the associated factors in relation to the occurrence of ED visits via ambulance for TP. All analyses were adjusted for the survey design.

Results: Overall 1.2% of the total TP visits to the ED were by ambulance ranging from <1% in 2003 to a high of 3% in 2011. The proportion of TP visits by ambulance was highest among public insurance enrollees (2.1%), 45-65-year-old (3.1%) and Hispanic (2.5%) patients. In the multivariable analysis gender, day of the week, region, race/ethnicity and reason for visits were not significant predictors of TP visits to the ED by ambulance. Compared to 25-44 years old, those aged 45-64 years old were significantly more likely to visit the ED by ambulance due to TP. Payment type and race/ethnicity were the strongest predictors of TP visits to ED by ambulance.

Conclusion: While ED visits that utilize an ambulance for TP are relatively uncommon, they do occur with some frequency, and have cost implications to the healthcare system. Study results suggest that adults (45-64 years old) and public insurance enrollees had higher odds of the use of an ambulance for ED visits for TP.

41. Reparative Potential of Migratory Progenitor Cells in Injured Mandibular Condyle Cartilage and Articular Disc

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Degeneration of cartilage surfaces in temporomandibular joint (TMJ) disorders causes pain and disability and seldom resolves spontaneously; thus, there is a need to develop regenerative therapies. We have developed a promising strategy to stimulate cartilage regeneration by endogenous stem/progenitor cells. In previous studies, migratory chondrogenic progenitor cells and meniscus progenitor cells were recruited to injured tissues, where they showed a capability for in situ tissue repair. The purpose of this study was to determine whether such cells are present in TMJ.

TMJ explants were obtained from young adult goats and rabbits. Cartilage surfaces were scratched with a needle, causing cell death and matrix damage. Full-thickness cartilage defects were made in other explants with a 2-mm-diameter biopsy punch. Scratched explants were cultured for 10 days and processed for confocal examination. Migrated cells were trypsinized and processed for cell migration assay with stromal-derived factor-1alpha (SDF-1α) and white blood cell (WBC) lysates as chemoattractants. Defects were filled with a fibrin/hyaluronic acid hydrogel and were cultured for 3 weeks with or without 1.5×10^6 WBC lysates and 1 μM N-[N-(3,5-Difluorophenacetyl)-L-alanyl]-S-phenylglycine t-butyl ester (DAPT), a Notch inhibitor that induces chondrogenic differentiation of progenitor cells.

Migrating cells repopulated scratched areas in both mandibular condyle cartilage (MCC) and disc. WBC lysates significantly increased the number of migrated cells ($p<0.001$). SDF-1a enhanced MCC cell migration, but the effect was not significant. Defects were repopulated when WBC lysates were added to the hydrogel filler. DAPT treatment induced the formation of hyaline cartilage matrix by these cells.

In conclusion, this study showed that endogenous progenitor cells have a great potential for the regeneration of TMJ cartilage. Our findings have important implications for intrinsic MCC and disc repair.

42. Accuracy of Using Automatic or Blended Techniques for Mandibular Segmentation

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Objective: 3D printing or additive manufacturing, a process where layers are placed one at a time to create objects, is poised to revolutionize dental prostheses creation. This preliminary research is to assess the accuracy of 3D printed objects manufactured using either an automatic or blended (automatic and manual) segmentation process.

Materials and Methods: Two dry skull mandibles were scanned using an iCAT FLX cone beam CT machine. Scanning was done in different voxel resolutions (0.30mm, 0.25mm, and 0.20mm) at 16cm x 8cm field of view. The scans were exported as DICOM files to an open source segmentation software (3DSlicer). Segmentation of the mandible 1 was done using automatic segmentation for the three different scan resolutions. Mandible 2 was segmented using the blended approach. A total of six different 3D models were printed in a Fortus 400mc 3D printer at a thickness of .005 inch using ABS M30i (thermoplastic material used in 3D printing). Linear measurements of the two mandibles and six 3D printed models were measured and analyzed results.

Results: Initial results indicated that there was no significant difference between the dry skull mandibles and the models but the condylar borders were better depicted in the blended segmentation models.

Conclusion: Current research concluded that using a blended approach to segmentation is a better alternative to automatic segmentation especially if finer structures are to be depicted with accuracy but the use of either technique is sufficient if it involves larger linear structures. Further research using angular and textural analysis has to be conducted to confirm the validity and reliability of both segmentation techniques for different conditions.

43. Analysis of Low pH Streptococci from Early Dental Caries in Children

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Purpose: The microbiological understanding of caries has focused on the role of mutans streptococci (MS), however, there is debate on the actual impact the MS have on the etiology and perpetuation of caries. This pilot study focused on isolating streptococci from healthy sites or sites with early caries to quantify their acidogenic potential in an effort to link acidogenicity with overall caries risk. We hypothesize that there are several species of streptococci that possess acid properties conducive to the development of caries.

Methods: Plaque samples were collected from 14 children (ages 3 to 10 years) receiving treatment at the University of Iowa College of Dentistry, Department of Pediatric Dentistry (IRB ID# 201604795). These samples were plated on media selective for streptococci and 31 colonies from each subject were grown overnight in Brain Heart Infusion (BHI) broth and Chemically Defined Medium (CDM) for determination of terminal pH.

Results: Significant subject to subject variability was detected among the average terminal pH of the isolates ($P<.05$). As expected, terminal pH tended to be higher in BHI than CDM media whether pooled ($P=.0031$) or considered separately by cohort (control $P=.0313$, caries group $P=.0469$). No difference was detected in average terminal pH between the two cohorts in either media.

Conclusions: There were no statistically significant differences in terminal pH when comparing streptococcal isolates from early dental decay to those from healthy sites. Limitations include the small sample size and potential reduction in viable organisms within stored plaque samples.

44. Comparative Study of Dosimetry in Two Cone Beam CT Devices

Daniah Alhazmi[1], G. Axt[1], S.L. Sousa Melo[1], *V. Allareddy*[1]

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Background: Cone beam computed tomography (CBCT) has been widely used over the last decade in dentistry, especially in implant treatment planning, evaluation of pathosis, orthodontics, and endodontics. Imaging demand has led to development of a wide variety of machines with different radiation dose exposures. Although these CBCT units with a relatively small field of view provide a lower dose than a multi-detector CT unit, the radiation exposure is still cumulative over a life time. With the possibility of long term X-rays risk from diagnostic imaging, patient dose reduction has to be considered when selecting imaging modalities.

Objectives: The aim of this study is to compare the dosimetry levels in two CBCT devices, the i-CAT FLX and Kodak units.

Methods: A cylindrical phantom of polymethylmethacrylate (PMMA) (16 cm in diameter) with a Radcal MDH model 1015 using 10x5-3CT pencil ionization chamber were used to measure the doses from the i-CAT FLX and Kodak machines. The 8 x 8 cm FOV in i-CAT FLX and 7 x 8 cm FOV in Kodak at different settings were used in the study. In order to calculate a reliable measure of the radiation in the ionization chamber, the phantom had to be exposed at least three times at the same place. The radiation dose was read by an oral and maxillofacial resident.

Results: Preliminary results indicate that the smallest field size (8 x 8 cm) with the highest resolution in i-CAT FLX unit provides a significantly lower radiation exposure compared to a similar field size from Kodak unit.

Conclusions: Dosimeter readings are positively impacted by the X-ray parameters in particular scan time, resolution and field size. The ability to select these parameters in the new generation i-CAT machine are important factors to reduce the patient exposure to the x-ray beam.

45. Endodontic Board Certification: A Review of Factors Affecting the Certification Rate

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Purpose: Board certification validates the expertise of clinicians who possess advanced proficiency within their field. Only 23% of endodontists are board certified, the lowest among all dental specialties. The aim of this study is to determine the factors that influence endodontists' decisions regarding completion of board certification.

Methods: A 16-question survey was emailed to 5,073 AAE members, U.S. endodontists and residents.

Results: A total of 1603 endodontists and residents responded. Of those respondents, 73.8% felt board certification was important. Among endodontists, 32% were board certified, 24.4% had plans or were in the process of becoming board certified, and 43.6% had no plans to become board certified. The most common reasons for forgoing board certification were "graduated too long ago," "don't have time," "process is too long," and "not required to become an endodontist." Board certified endodontists were more likely to believe board certification was important compared to their non-board certified counterparts (97.5% vs. 60.3%; p<.0001), and were more likely to have received training at programs that encouraged and provided assistance in completion of board certification. Residents were more likely to plan on becoming certified compared to non-board certified endodontists (89.6% vs 35.9%).

Conclusions: Despite widespread agreement regarding the importance of board certification, a strikingly low percentage of endodontists are board certified. Views provided by endodontists and endodontic residents should be considered by the ABE, AAE, and residency training programs to implement changes that will effectively increase the percentage of board certified endodontists.

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

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Introduction: Proper diagnosis is perhaps the most important aspect for success of endodontic therapy. The goal of this *in vivo* study was to assess the validity of a cold thermal test (Endo Ice: 1,1,1,2-tetrafluoroethane) to determine pulp vitality on crowned teeth and to determine the effect of several variables on the reliability of the test.

Materials and Methods: Data were collected from 112 patients in need of endodontic therapy seen in the Endodontic Clinic at the University of Iowa College of Dentistry and Dental Clinics. Inclusion criteria included the presence of a crown. 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: The sensibility test results showed accuracy, 0.893; sensitivity, 0.853; specificity, 0.910; positive predictive value, 0.806; and negative predictive value, 0.934. Younger subjects were more likely to obtain true positive results to testing (p = 0.0053). Subjects with single rooted teeth were more likely to have true negative results to testing (p = 0.05). No significant differences were found with regard to gender, tooth type, type of crown and recent use of analgesic (p>0.10 in all instances).

Conclusion: Pulp sensibility testing with Endo Ice through crowns is a reliable method for determining pulpal vitality. No statistically significant difference was found among different crown types in this study.

47. Surface Modifications of Zirconia on In-Depth Transformations and Flexural Strength

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Objective: to assess the phase transformation and associated ferro-elastic domain switching (FDS) depth, and flexural strength of dental zirconia (BruxZirTM), after chairside surface treatments.

Materials and Methods: Square-shaped specimens (n=20) were sintered according to manufacturer's recommendations. They were left as-sintered (AS; control), air abraded with fine (AAF) or coarse (AAC) alumina particles, ground (G) or ground and polished (GP) following recommended protocols. Roughness (Rq) was measured by profilometry. Crystalline phases were investigated by grazing incidence x-ray diffraction (GIXRD) (n=3). GIXRD data was fit using various regression protocols. The depth of the transformation and FDS was interpolated from regression analyses. The mean biaxial flexural strength was measured according to ISO 6872. A bonded polished interface configuration was used to assess subsurface damage by optical microscopy and SEM. Results were analyzed by Kruskal-Wallis test and Tukey's adjustment for multiple comparisons. A 0.05 level of significance was used.

Results: All treatment groups exhibited a significant difference in mean surface roughness and biaxial flexural strength compared to AS group (p<0.05). AAF group showed the highest mean biaxial flexural strength (1662.62 ± 203 MPa) with flaw sizes (5.9±1.8 µm) smaller than transformation depth (14.5±1.2 µm) and FDS depth (21.0±2.9 µm), followed by GP group (1567.19 ± 210 MPa) with smallest FDS depth (9.3±2.0 µm) and flaw sizes (2.6±1.8 µm), but without m-phase. AAC group (1371.37 ±148 MPa) had the largest flaw sizes (40.3±20.3 µm), transformation depth (47.2±3.0 µm) and FDS depth (41.2±2.2 µm). G group (1357.0 ±197.0 MPa) had the lowest transformation depth (8.6±1.5 µm), and median FDS depth (23.8±1.7 µm) and flaw size (18.6±3.1 µm).

Conclusion: The flexural strength is determined by the balance between mean flaw size and transformation depth. AAF is the most efficient in promoting transformation and FDS, leading to high flexural strength if flaw size remains lower than transformation depth.

48. Management of Initial Caries Lesions: An Iowa Survey

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Objective: The purpose of this study was to investigate factors related to Iowa dentists' management of initial caries lesions for low, moderate and high-risk patients and their agreement with the International Caries Classification and Management System (ICCMS) Guidelines.

Methods: A survey with three patient scenarios (low, moderate and high-risk) was electronically sent to 916 University of Iowa alumni dentists who were in active practice. Information on dentists' demographics and practice characteristics were also collected in the survey. Descriptive statistics were conducted to profile the variables of interest. Bivariate analyses were performed to assess the factors associated with the management of initial caries lesions for each scenario.

Results: 138 (response rate=15%; male=83 and female=55) practicing dentists in Iowa completed the survey. Of these (mean age=48.3±12.3 years, mean years of clinical practice=21.4±12.5), 70% completed a formal post-graduate training program, and 35.5% were solo practitioners. Agreement with ICCMS guidelines regarding the management of initial caries lesions for low, moderate and high-risk scenarios was 72.5%, 58.7%, and 51.4% respectively. Dentists who routinely dried teeth with compressed air for caries detection were more likely to agree with ICCMS for the low-risk scenario (p=0.0366). For the moderate-risk scenario dentists who were younger, recently graduated, had postgraduate training, practiced in group/public health practice, were familiar with ICDAS, ICCMS and CAMBRA, and used magnification for caries detection were more likely to agree with ICCMS (p<0.05 in each instance). For the high-risk scenario, dentists who had postgraduate training (p=0.046), practiced in group/public health practice (p=0.025), were familiar with ICCMS (p=0.0779) and frequently performed caries risk assessment for their patients were more likely to agree with ICCMS (p=0.0252).

Conclusion: Iowa dentists had the highest agreement with the ICCMS guidelines for low-risk scenario and agreement was associated with routinely drying teeth for caries detection.

49. Observer's Performance in Detecting Caries-Like Lesions on Multiple Displays

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Background: Digital imaging is a well-established diagnostic tool in dentistry. Enamel carious lesions are a basic but nonetheless challenging entity to diagnose. Radiographic display platforms are forever changing in quality and now portability.

Objectives: To evaluate the influence of four different displays on the diagnosis of artificial caries-like lesions in restored and unrestored teeth.

Materials and Methods: 60 extracted human teeth (30 premolars and 30 molars) were selected. All molars had class II cavities prepared and restored. Half of the premolars and molars were randomly selected and a 7mm≤ area was exposed to a demineralizing solution for 90 days. Phantoms with four teeth (two premolars and two molars) were created. Periapical radiographs were obtained on VistaScan phosphor plates. The images were evaluated under subdued lighting on four viewing displays (Barco MDNC-3321, NEC Wide, Apple Ipad Pro and Microsoft Surface Pro 4) by three observers using a five-point rating scale. Sensitivity (Sn), specificity (Sp), accuracy (Ac) and the areas under the curve (AUC) were calculated and compared by Analysis of variance and post-hoc Tukey test.

Results: Even though the tablets improved accuracy by 2.2-5.8% over the medical monitors, there was no statistically significant difference in sensitivity, specificity, accuracy or AUC among the four monitors when the same tooth group was considered (p>0.05). The performance of the monitors were statistically superior when the demineralization was located on a restoration-free surface (p<0.001).

Conclusion: There is no perceivable disadvantage to utilizing a higher resolution tablet viewing platform for plane images. Both tablets improved detection accuracy on the unrestored premolars. The subtleness of early enamel caries is diagnostically challenging, it then stands to reason that the tablet platforms are adequate for evaluation of anatomy and pathoses with distinct characteristics. However further research is needed to expand tablet display applications.

50. Pediatricians' Behavior, Comfort, and Knowledge after Infant Oral Health Training

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Purpose: The purpose of this study was to compare the oral health knowledge, perceived comfort, and behavior regarding infant oral health between pediatricians who received training during residency at the University of Iowa Infant Oral Health Program (IOHP) versus those who did not.

Methods: A questionnaire was sent to 87 pediatricians who graduated from the University of Iowa Hospitals and Clinics Pediatric Medicine Residency program between 2010 and 2016. The questionnaire consisted of 12 questions regarding infant oral health knowledge, practice behaviors, perceived comfort levels in assessing oral health, and willingness to provide fluoride treatments. The questionnaires were sent using a web-based survey site. Non-respondents were mailed paper copies after 2 unsuccessful attempts. Descriptive statistics, bivariate analysis, logistic regression analysis were used for the statistical analysis (alpha=0.05).

Results: TBD

Conclusions: TBD

51. Prevention of Tooth Discoloration Using Dentin Tubule Coverage: An *ex vivo* Study

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The purpose of this experiment is to determine if a glass ionomer (GI) or bonding agent (BA), applied to the inner walls of the pulp chamber prior to placement of Mineral Trioxide Aggregate (GMTA), could prevent the staining effects on the natural crowns of human teeth. 160 freshly extracted human premolar teeth were selected. Access cavities were prepared and teeth were randomly assigned to one of 4 groups: group 1, negative control (sterile cotton pellet only); group 2 (GI); group 3 (BA); group 4, positive control (GMTA only). In groups 2 and 3 respectively, GI and BA was applied to the walls of the access. 3mm of GMTA was placed in the access cavities which were subsequently

sealed. Spectrophotometric analysis was assessed at 4 time points: baseline, 1 week, 1 month, and 3 months. Change in color (ΔE) was compared among groups and over time using analysis of variance, followed by the post hoc Tukey's honestly significant difference test. Preliminary results show the mean values of ΔE for groups 1, 2, and 3 all had an initial increase with a subsequent stabilization of color. Whereas, the mean value of change in E for group 4 increased through all time points. Groups 2 and 3 that had dentin tubule coverage and filled with GMTA showed markedly less staining over 3 months than the positive control group with GMTA only. Application of BA or GI prior to placement of GMTA in the pulp chamber of natural crowns can prevent tooth discoloration after 3 months.

52. Retrospective Study of Factors Associated with Success of Stepwise Excavation

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Objectives: This study evaluated patient factors predicting successful stepwise excavation procedure (SWP), defined as a tooth treated with a direct or indirect restoration (within 36 months after the first appointment) and not needing root canal treatment or tooth extraction.

Methods: This study assessed the clinical outcomes of SWPs completed in 1,326 patients, who did not report clinical symptoms of irreversible pulpitis, at the University of Iowa College of Dentistry between January 2004-December 2012. Bivariate associations of categorical covariates with the primary outcome were assessed using χ^2 tests of association, while Wilcoxon rank sum tests were used for quantitative variables. Multiple logistic regression modeling was used to model the probability that a successful SWP was achieved within 36 months of the first appointment of the SWP and to identify demographic factors (patients' age, gender, dental insurance, number of recalls prior to SWP) and tooth-specific characteristics (tooth arch, tooth type, total surfaces treated, type of provider) significantly associated with the probability of success.

Results: SWPs had a 75% success rate when evaluated within 36 months of the initial treatment. The final multiple logistic regression model included two predictors: re-entry interval and age. Findings showed that younger patients were more likely to have a successful SWP treatment than were older patients

(OR=0.981; 95% CI = 0.967-0.994; p = .0055). Patients who returned to their second appointment within 5-7 months were more likely to have a successful SWP treatment than those returning in less than 5 months (OR = 0.338; 95% CI = 0.210 - 0.545; p < .0001).

Conclusion: Results suggest that treating deep carious lesions with SWP is effective for pulp preservation. Clinicians should consider the age of the patient, when deciding upon SWP. Additional investigations, such as long-term longitudinal studies, are needed to better identify factors influencing the success of SWP.

53. Select State Initiatives on Integrating Oral Health and Chronic Disease

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[1]University of Iowa, Iowa City, IA; [94]Centers for Disease Control & Prevention

Objectives: The relationship between oral health and chronic diseases is well-documented in literature, however, there still exists a gap in integration of the two domains. The objective of this study was to evaluate accomplishments in medical-dental integration by state oral health programs and identify best practices that can be implemented within other oral health programs.

Methods: The Division of Oral Health at the Centers for Disease Control & Prevention in collaboration with the Association of State & Territorial Dental Directors supports 21 state oral health programs. Initiatives toward chronic disease integration were reviewed from all 21 states. Based on the diversity of the oral health-chronic disease collaboration, current status, and effectiveness of the program, select programs from five states — Iowa, Maryland, New York, Vermont, and Virginia were chosen to be comprehensively evaluated.

Results: Iowa collaborated with heart disease and tobacco cessation programs. Educational sessions on conducting blood pressure screening and tobacco counselling were provided to dental professionals. Maryland focused on integrating oral healthcare and diabetes. A conference was conducted to increase knowledge and skills of dental providers at recognizing prediabetes in patients and providing diabetes prevention resources. Programs educating dental students to use a glucometer to screen and identify patients with prediabetes were also initiated. New York and Vermont worked with state tobacco control programs to expand smoking cessation programs to

dental providers. Vermont also conducted a medical-dental integration conference to explore how medical and dental professionals can collaborate to impact overall health. Virginia worked with community health workers and local area agencies on aging to improve oral health counselling skills and knowledge.

Conclusions: There is an increasing awareness of the importance of oral health and chronic disease integration. While various approaches initiated by select states have successfully integrated the two domains, steps should be taken to strengthen and further this collaboration nationwide.

54. Survival of Molar Root Canal Therapy in Pediatric Patients: A Retrospective Analysis

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Introduction: Molar root canal therapy is a technique sensitive and complex procedure performed on conscious pediatric patients. The aim of this study was to determine the survival rate of molar root canal therapy performed in patients, age 7 to 18, at the University of Iowa College of Dentistry.

Methods: Of 2,276 molar root canals performed from 1985 through 2015, electronic charts were available for 650 teeth to evaluate the survival status with a minimum follow-up period of 1 year. Data collected included gender, age at treatment, arch, insurance coverage, restoration type, and tooth vitality. The Kaplan-Meier analysis and chi-square test were conducted to test the statistical significance of differences between the survival curves or in survival rates associated the aforementioned variables (alpha=0.05).

Results: Overall survival rate at 45 months (median time) was 84%. Teeth in the maxilla (79% Maxilla, 68% Mandible; p=0.0051) and restoration type (89% for Full Cast Crown (FCC), 89% for Stainless Steel Crown (SSC), 79% for Composite, 71% for Amalgam, and 20% for Temp; p < 0.0001) were significantly associated with the survival rate. Gender, age, vitality, and insurance coverage type were not significantly associated with survival status

Conclusion: The four year survival rate was 84% Maxillary arch and teeth restored with either a SSC or FCC showed significantly greater survival rates.

55. Pitx2 Controls DESC Proliferation and Differentiation by Targeting the Dental Epithelial Signaling Center
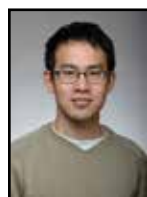
Wenjie Yu[1], *B.A. Amendt*[1], S.L. Eliason[1]

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Pituitary homeobox 2 (Pitx2), the gene responsible for human Rieger syndrome, plays a crucial role in odontogenesis. Although the function of Pitx2 in tooth development is well established, detailed cellular and molecular mechanisms of Pitx2 regulation remain unclear. Here, we conditionally ablated Pitx2 in dental epithelium by using K14-Cre, tooth development is arrested at bud stage with smaller bud size and less cells in K14CrePitx2f/f mice. BrdU incorporation analysis showed that cell proliferation is down-regulated in†K14CrePitx2f/f teeth. In addition, we found that Sox9+ cells are reduced in the dental epithelium in†K14CrePitx2f/f teeth, indicating that cell differentiation is down-regulated. Mechanistically, Pitx2 regulates the expression of Cyclin D2 and Irx1 to promote bud tooth formation.†In conclusion, we have uncovered a new Pitx2 dependent regulatory network during early tooth development.

56. Hydrogen Peroxide Penetration and Tooth-Whitening Efficacy of Innovative Double-Layer Technique

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Objectives: To measure level of hydrogen peroxide (HP) penetration into the pulp chamber and to evaluate whitening efficacy when treated with innovative double-layer of potassium nitrate (PN) desensitizer and HP whitening gel.

Methods: Extracted human molar teeth (n=160) were collected. Roots were trimmed 3mm apical to the cemento-enamel junction, pulp removed and a cavity prepared, leaving a standardized wall of 2mm thickness, which retained 100μL of acetate buffer solution. A standardized whitening area of 6mm in diameter was established buccally by painting the rest of the tooth with grey nail varnish and teeth were randomly assigned into four groups. Group 1: no

treatment (glycerin gel, negative control); Group 2: double-layer of 20μL 5% PN (Relief ACP, Philips Oral Healthcare) and 100μL 25% HP (Zoom Chairside Whitening Gel, Philips Oral Healthcare); Group 3: double-layer of 40μL 5% PN and 100μL 25% HP; and Group 4: 100μL 25% HP (positive control). All groups received three 45-minute sessions of in-office whitening with light activation at 3-day intervals. HP penetration was assessed spectrophotometrically using leucocrystal violet and horseradish peroxidase. Color measurements were assessed with VITA Easyshade at baseline, 1-day, and 4-week post-whitening. Tooth color change was measured per Commission Internationale de l'Eclairage methodology. One-way ANOVA with Tukey multiple comparisons adjustment was performed to compare group differences in overall tooth color change (ΔE^*) and HP penetration (type I error = 0.05).

Results: HP penetration levels were not significantly different between Group 2 and Group 4, however, significantly higher level compared to Group 1 and Group 3 ($p<0.0001$). Groups 2, 3 and 4 showed no differences for overall tooth color change, but differed significantly from negative group (Group 1) at 1-day and 4-week post-whitening.

Conclusions: The use of potassium nitrate/hydrogen peroxide double-layer technique affected hydrogen peroxide penetration, however, double-layer technique did not adversely affect the whitening efficacy.

57. CAD/CAM Resin-Bonded Fixed Partial Dentures (RBFPDs)

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Objectives:

1. Define the case selection criteria, treatment planning and prosthetic design for CAD/CAM RBFPDs.
2. Demonstrate a step-by-step procedure for predictable fabrication of esthetic restorations.
3. Discuss the benefits and challenges of CAD/CAM technology with regards to designing and fabrication.

Congenitally missing teeth continue to present a restorative challenge in clinical dentistry with regards to treatment option and treatment planning. Current treatment modalities with different therapeutic approaches for the missing teeth involve tooth-support restorations with conventional full coverage or resin-bonded fixed partial prosthesis, and the implant restorative treatment. Conservatively, RBFPD is increasingly being used in modern dentistry as an alternative to more destructive treatments. This has been driven by the advent of evidence-based dentistry showing the benefits to patients of reduced tooth preparation and the importance of an intact enamel structure for the long-term health of the teeth.

This table clinic will present a clinical case of computer-aided design/computer-aided manufacturing (CAD/CAM) RBFPDs in a patient with congenitally missing teeth in mandibular after orthodontic corrections. The presentation will elaborate on the case selection criteria, diagnosis, treatment planning and multidisciplinary approaches using digital dentistry technologies including digital photography, smile analysis and CAD/CAM technology.

Recent advances in dental materials and digital technologies have changed the way of contemporary clinical dentistry. This clinical case designed and fabricated multiple RBFPDs using CAD/CAM technology. The digital approaches to impression making, designing and restoration fabrication coupled with strong ceramic materials are paving the way to less time-consuming process, more predictable and satisfactory esthetic results. A step-by-step process of the digital workflow will be presented with a discussion of the advantages and disadvantages of this innovative system.

58. Alveolar Ridge Healing and Dimensional Changes Following Tooth Extraction

Sarah A. Rinehart[1], *G. Avila Ortiz*[1]

[1]University of Iowa, Iowa City, IA

Background: The extraction of a tooth initiates a series of events that contribute to the healing and remodeling of the alveolar ridge. This process of remodeling leads to alterations in the anatomy and changes in the volume of the hard and soft tissues of the edentulous site. These changes can have significant impact on future restorative options and many current research studies aim to better understand how to predict the amount of change expected.

Objective: The aim of this presentation is to discuss the healing process of the alveolar ridge following tooth extraction and the volumetric changes that occur following tooth extraction. This will include discussion of current research on these topics as well as the discussion of novel techniques that can be used to assess the volumetric changes that take place in both the hard and soft tissues.

Conclusions: The healing following tooth extraction is a complex, multi-factorial process. There are many factors that may influence the amount of volumetric change that occurs, but at this time further research is needed as the anatomic and volumetric changes following tooth extraction can be unpredictable at times.

59. Non-Surgical Treatment Strategies and Outcomes in Patients with Severe Class II Division I Malocclusions

Lina Alsibaie[1], S. Howes[1], K. Shin[1], *Vs. Allareddy*[1]

[1]University of Iowa, Iowa City, IA

Class II malocclusions are the most common malocclusions treated by an orthodontist. A multitude of non-surgical options are available to treat patients with severe Class II Division I malocclusions. In this table clinic, we provide an overview of different non-surgical orthodontic treatment approaches that are in vogue and present end of treatment outcomes from 37 consecutively treated Class II Division I (overjet >=6 mm) malocclusion patients. The different treatment approaches include: head gears, functional appliances, temporary anchorage devices, and extractions of permanent teeth. The most frequently recommended retention protocol was clear retainers on the day of debanding followed by Hawley retainers. Two-phased treatment was done in 38% of patients. Two-phased treatment plan was not significantly associated with need for extractions of permanent teeth during the final comprehensive phase of orthodontic treatment (Odds Ratio is 0.52, 95% CI is 0.12-2.16, p value is 0.37). There are no significant differences in end of treatment cephalometric outcomes (SNA, SNB, ANB, angulation of maxillary incisors to SN plan, angulation of mandibular incisors to mandibular plane, FMIA, and lower anterior facial height) between those who underwent a two-phased treatment and those who underwent a single-phase of comprehensive orthodontic treatment. Those who underwent extractions had a greater reduction in the overjet (1.2 mm reduction, p=0.01) and increase in ANB angle (1.4 degrees more, p=0.02). None of the other end of treatment cephalometric outcomes were significantly different between the two groups (extraction versus non-extraction).

60. Prospective, Comparative Assessment of Alveolar Ridge Preservation Using Guidor® Easy-Graft® Classic in Atraumatic Extraction Socket

Kelsey Tengan[1], *G. Avila Ortiz*[1]

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Following tooth extraction, the alveolar ridge undergoes a process of bone remodeling which results in marked dimensional changes in both the horizontal and vertical direction. With the physiological loss of ridge volume, proper axial alignment of an implant for a functional and aesthetically pleasing prosthetic treatment outcome may be challenging. To minimize alveolar bone atrophy in the course of wound healing, "ridge preservation" techniques have been developed. This typically involves filling the extraction socket with bone or bone graft substitute and/or covering it with a barrier membrane. A broad range of grafting materials from autogenous, allogenic, and xenogenic sources have yielded positive results in ridge preservation procedures. Synthetic bone grafting materials have also been studied in ridge preservation studies. The most common alloplastic material is β-tricalcium phosphate (β-TCP). Easy-graft CLASSIC is a commercially available alloplastic bone graft that consists of pure β-TCP with a thin coating of poly(lactic-co-glycolic acid) (PLGA). When combined with the supplied solvent, the graft becomes moldable until contact with blood or tissue fluids. Upon contact with blood in the bone defect, it hardens to form a stable porous scaffold for bone regeneration. This unique property of the graft material benefits both the patient and the dentist by decreasing treatment time and negates the cost of a membrane or collagen plug and sutures required with traditional particulate grafts. The main purpose of our ongoing randomized controlled clinical study is to compare the effectiveness of Easy-graft CLASSIC to FDBA with collagen plug in ridge preservation procedures after tooth extraction. In this table clinic, we will share our preliminary clinical and technical impressions after having worked with this novel biomaterial.

61. Effect of Arginine on Conversion of an Experimental Dental Adhesive

Elliott Glenn[1], *S.R. Armstrong*[1], S. Geraldeli[43], M. Nascimento[43], F. Qian[1], J. Jessop[1], R. Maia[1], E.C. Teixeira[1]

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Objectives: The amino acid arginine has useful anti-caries properties due to the arginine deiminase pathway whereby the bacterial byproducts become less acidic. The addition of arginine to dental adhesives as an antibacterial agent is currently being investigated. The addition of arginine to an adhesive resin system must not diminish the chemical and mechanical properties for future clinical applications. Therefore, the objective of this study was to measure the degree of conversion (DC) and peak rate of conversion of the arginine-containing adhesive resin system.

Methods: Two types of adhesive (n=6 per group), one experimental with 7% arginine and the control were prepared and tested. Real time Raman spectroscopy was used to measure DC and peak rate of reaction while curing with an incident irradiance of $320mW/cm^2$ at 320-500nm wavelength. Two-sample t-test was performed to evaluate the difference between the two adhesive types on DC and rate of polymerization (alpha=0.05).

Results: The mean DC of the arginine adhesive (73±2 %) was significantly higher than that observed in the control adhesive (70±2 %) (p=0.0105). There was no significant difference in peak rate of conversion between the two types of adhesive (arginine adhesive: 2.70±0.52 %/sec, control adhesive: 2.58±0.72 %/sec; p=0.7446).

Conclusions: The addition of 7% arginine to the experimental adhesive significantly increased the degree of conversion while not altering the rate of conversion.

62. microRNA-26b-5p Targets Lef-1 to Regulate Molar and Incisor Development

Steven L. Eliason[1], M. Romero-Bustillos[1], N.E. Holton[1], *B.A. Amendt*[1]

[1]University of Iowa, Iowa City, IA

A microRNA-26b-5p (miR-26b) over-expression (OE) mouse was generated to understand the role of miR-26b during embryonic development. The miR-26b over expression mice have craniofacial defects including a lack of incisors, molars and hair. miR-26b over-expression mice have arrested early tooth development coincident with decreased epithelial progenitor cell proliferation. We demonstrate an inverse co-orelation between miR26b levels and lef1 expression in the craniofacial region of these mice. miR-26b targets Lef-1 to modulate Lef-1 transcriptional activity. Both cyclin D1 and c-myc expression are decreased as well as other cell proliferation mechanisms. miR-26b expression correlates with the transition of Lef-1 expression in the dental epithelium. miR-26b regulates all Lef-1 isoforms and Wnt signaling, dependent on the Lef-1 isoform expressed in specific dental tissues. Oral epithelial-specific overexpression of Lef-1 can rescue these specific tooth defects. This is the first demonstration of a mouse model for miR regulation that has tooth agenesis. miR-26b regulation of Lef-1 is essential for normal tooth and craniofacial development.

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Ms. Sharon Seydel Receives UI Outstanding Staff Award

Ms. Sharon Seydel, department administrative manager in the Iowa Institute for Oral Health Research, was one of six UI employees to receive the University of Iowa Outstanding Staff Award. The awards were given during the October 5 Faculty & Staff Awards Banquet, which was held at the Levitt Center for University Advancement.

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