Pitt Dental Medicine is ranked number four for National Institute of Dental and Craniofacial Research (NIDCR).

The profound research performed at Pitt Dental Medicine is responsible for the steady improvement in rank over nearly two decades—validation of our commitment to exploration, investigation and analysis, and to the quality of the innovation being created here.

“This ranking is reflective of our alignment with the goals for research set forth by the NIH. Pitt Dental Medicine has been ranked in the top 10 for almost a decade, but this move into the top 5, at number 4, is significant. It reflects a long-term approach to becoming one of the premier dental research institutions in the country—in the world. It is a powerful statement of our staying power and the decades of hard work toward international acclaim.”

Bernard J. Castelloe DMD MD
Dean

“Pitt Dental Medicine has been engaged in top-notch, world-class research for many years. Being in the top 5 of NIDCR funding is particularly rewarding, though, because it is the major metric of U.S. Dental School research strength. Pitt is now shoulder-to-shoulder with other particularly strong research dental schools. Our research is at the cutting edge and applies state-of-the-art approaches to establish major research programs that, as evidenced by the success in getting grants, are widely recognized by other researchers outside of Pitt. Contributing to our research strength are the many productive collaborations with faculty investigators at Pitt, across the country and worldwide.”

Mary Meroschke PhD Director of the Center for Craniofacial and Dental Genetics

“This ranking is important to the dental field, our school, and our basic and clinical faculty, as the new knowledge generated will improve patient care and the health of the whole population. Our cutting-edge research is important to patient therapy—the knowledge that they will receive the most advanced care. Our students and alumni should feel a sense of pride in their Pitt Dental Medicine home.”

Charles Sfeir DDS PhD Associate Dean for Research

“The rankings validate the effort and talent of our faculty and staff and also demonstrate that we, as an institution, are “all in” with our support of the research missions of the dental profession and the University of Pittsburgh. Unquestionably, the new knowledge that our research generates will be important to improving patient care and population health. The “top 5” ranking, while arbitrary, is certainly something that brings attention to our school and will support our efforts to establish a sustainable research infrastructure. Maintaining that status is a worthy goal and one that, ideally, will continue to motivate us to continue achieving at the highest level.”

Robert Weyant MS DMD DrPH Associate Dean for Dental Public Health and Community Outreach

“The School of Dental Medicine’s ranking is an indication of its prominence in both dental research and in the training of new dental professionals. The school’s success reflects our campus-wide commitment to excellence at the University of Pittsburgh. I congratulate Dean BJ Castelloe and all of the school’s leadership, faculty, staff and students on this achievement.”

Arthur S. Levine MD Senior Vice Chancellor for the Health Sciences and John and Gertrude Petersen Dean, School of Medicine
In 2000, Dr. Mary Marazita became the Associate Dean for Research at the School of Dental Medicine. At that time, the research taking place at the school was not necessarily reflective of a school of this size. Additionally, many clinical researchers were working hard without sharing or learning about other research at the school.

Her vision to encourage research efforts was to set aside a day to celebrate and bring attention to the high-quality research going on “just down the hall” at the dental school. So, in 2001 she coordinated the first School of Dental Medicine Research Symposium in Scaife Hall. After 17 years, it has become the longest-running symposium at Pitt—and with good reason.

In 2002, while still focusing on research performed here at the School of Dental Medicine, she invited Raymond White from the University of North Carolina to be the keynote speaker. By expanding the event to include significant speakers from outside of Pitt, she began a tradition of inspiring faculty and student researchers through presentations by academics from other schools and institutions, as well as introducing research taking place at the school to researchers outside of the school.

2004 The Symposium broadened to include a luncheon for attendees. Student attendance became required for the event.

2012 The event continued to grow in attendance and significance. Concurrently, NIH funding increased to over $5 million by 2013. The School of Dental Medicine had become a significant force in dental medicine research.

2013 Dr. Charles Sfeir became Associate Dean for Research and continued to improve the event, which is the premier research event at Pitt. New funding is influencing the importance of translational research—the process focusing on the development of treatments based on research findings—and the School of Dental Medicine is influencing research worldwide.
Dear colleagues and friends,

It is my great privilege to welcome you to our Research Symposium at Pitt Dental Medicine. This event is one that I look forward to each year. I see this occasion not only as a celebration of our successes in research but also as a jumping-off point for the great things our researchers will achieve in the future. We have much to celebrate and look forward to, as evidenced by the fact that we have achieved our highest ranking yet in the NIDCR rank list of funding to dental institutions, climbing to number four!

This accomplishment is a testament to the dedication of our researchers and the vision they hold for the future. Though their research ranges from core basic science, translational research, genetic studies to public health initiatives, it all shares an innovative spirit that sets it apart. By gathering together to see and support the progress of our researchers, we recognize the potential at Pitt Dental Medicine for even greater research achievements in the future.

Recently, becoming the Dean of our school has given me the opportunity to view our research programs in a new way, and I am eager to expand our impact and scope. Our research is key to achieving preeminence as a school. We are well on our way to making that vision a reality, and this is due to the substantial innovations and discoveries made by our team of exceptional researchers. Those efforts not only set a standard for advancing science and growing programs that focus on discovery, but also present an opportunity for our school to become a premiere school of dental medicine—one that strives to produce innovation in the lab and for our patients. As one example, this year Pitt Dental Medicine received an $11.7 million NIDCR grant with our partners at the University of Michigan and the Weiss Institute to substantially change the way we commercialize innovations. Through this grant our researchers have taken the additional step to accelerate the most promising ideas from many institutions into real patient solutions and products. At Pitt Dental Medicine, we believe that this progress is essential to the advancement of the dental profession as a whole.

I encourage each of you to explore the richness of our research programs and all of the exciting developments this work brings to the field. To participate in our research, as this symposium attests, not only allows you to share in our current, notable successes, but to become part of an effort to reach our tremendous potential. It is my honor to support this symposium and all that it represents for Pitt, and the health of all of us.

Sincerely,

Bernard J. Costello, DMD, MD
Dean and Professor
University of Pittsburgh School of Dental Medicine
Dear Pitt Dental Medicine friends,

It is a great honor to welcome you to the Eighteenth Annual Pitt Dental Medicine Research Symposium. Each year, we share and celebrate the accomplishments of the members of the School of Dental Medicine research community through this prestigious event. This year we are especially proud of being in the top 5 for National Institute of Dental and Craniofacial Research funding, placing fourth among dental institutions receiving NIDCR support. This is a reflection of the dedication to innovative research being performed by our faculty, who are at the forefront of dental research. These research achievements, which hold great promise for the future of dental medicine and overall health, garner national and international recognition and demonstrate significance of our position among noteworthy dental institutions.

This event is designed to showcase the depth and breadth of our research programs—from genetic studies of orofacial birth defects to advances in craniofacial regeneration. The Center for Craniofacial and Dental Genetics (CCDG) continues its studies of oral health in Appalachia and the cleft and lip palate studies, which are inter-university and international collaborations that focus on genetic variants that influence facial features and their development. In the Center for Craniofacial Regeneration, various regenerative therapies are being developed for the pulp, periodontium, bone and soft tissues. The School of Dental Medicine, with the University of Michigan and Harvard University’s Wyss Institute, is leading the Michigan-Pittsburgh-Wyss Resource Center: Supporting Regenerative Medicine in Dental, Oral and Craniofacial Technologies. This resource center is actively supporting promising projects from the clinical, academic and private sectors thereby bringing new technologies one step closer to patients. These research efforts truly illustrate our dedication and commitment to both the translational and basic science-focused spheres of research. While the pursuit of science itself is an admirable one, Pitt Dental Medicine looks not only to science, but beyond, to the patient-centered clinical applications where our research will benefit our friends, family and our whole community, now and in the future. To change one person’s life through dental advancements is worth our effort.

Our symposium speakers share our dedication. This year’s keynote speaker, Dr. Kenneth Hargreaves, DDS, PhD, Chair and Professor of the Department of Endodontics at the University of Texas Health Science Center San Antonio, will discuss the epidemic of opioid and substance use disorders, and research strategies in play to develop non-opioid pain killers to combat this epidemic. Three members of our faculty, Drs. Anitha Potluri, Timothy Erdle and Juan Taboas, will co-present on an exciting, innovative and rapidly evolving topic: Digital Dentistry. I am delighted that this topic, which I believe embodies the advancement and innovations in the dental field, is included in our program.

The innovative efforts embodied by these speakers are the type that permeate our entire school. The success of our research extends well beyond our researchers and their labs, into success in education and advances in patient care. Our dental students, residents and students in our masters and PhD programs benefit from the cutting-edge discoveries made within our school and usher in new generations of dentists who can embrace research to make them better clinicians and lifelong learners. Further, the success of our research means success for our patients because it enables us to provide the best dental treatment possible throughout the region and elevates our standard of care to a level that sets the bar for clinical advancement nationwide.

Our success in research brings us ever closer to our vision of excellence and innovation—a vision that encompasses all components of the school, from basic science to dental education to clinical care. As I look toward the future, I see how the fruits of all of our research endeavors benefit many through pioneering technologies, improved clinical practices and the increased understanding of genetics. As always, I am honored to be a part of this institution and glad to have the opportunity, year after year, to share with you all our progress and success.

Thank you,

Charles Sfeir, DDS, PhD
Associate Dean for Research
Center for Craniofacial and Dental Genetics

DISCOVERING THE GENETIC BASIS FOR MANY CRANIOFACIAL CONCERNS

The Center for Craniofacial and Dental Genetics (CCDG) is an innovative University of Pittsburgh Center of Excellence, located in the School of Dental Medicine and directed by Professor Mary L. Marazita. From its inception in 2001, the CCDG has grown to a team of about 40 faculty, staff, and students, and currently is housed in the Bridgeside Point 1 building, near the Hot Metal Bridge, not far from the University of Pittsburgh Oakland campus.

Current research priorities of the CCDG include: genomic and phenotypic studies of orofacial clefting in populations around the world, studies of the etiologic factors contributing to dental caries and other oral health issues affecting Northern Appalachian populations, and identification of the genes that impact variation in specific facial features. These priorities are spearheaded by CCDG faculty including Dr. Marazita and Dr. Seth Weinberg, plus an extensive network of collaborators within the University of Pittsburgh and at many other universities, worldwide.

“I have been dedicated to research that eventually will elucidate the causes of orofacial clefts and other facial birth defects.” —Dr. Mary Marazita

Several recent developments distinguish the CCDG research program. Most notably, new grant funding has been received for the oral health disparities project, for genomic studies of orofacial clefts, and for facial variation research. Furthermore, numerous important publications were completed in the last year in each of these areas.

Dr. Marazita received her PhD in genetics with an emphasis on biostatistics, from the University of North Carolina, Chapel Hill, followed by a postdoctoral fellowship in craniofacial biology at the University of Southern California. After holding faculty positions at UCSF and the Medical College of Virginia, Dr. Marazita joined the University of Pittsburgh in 1993 as Director of the Cleft Palate-Craniofacial Center’s Clinical Services team.

Dr. Marazita has been involved in the studies of a wide variety of human traits and disorders over the years, including birth defects, oral diseases, premature birth, behavioral and psychiatric conditions, diabetes, and many others. She has two current major research projects: genomic and phenotypic studies of orofacial cleft birth defects, and studies of genetic, microbiological and behavioral factors impacting oral health in children.

Dr. Marazita’s involvement in orofacial cleft research traces its roots back to her time as a postdoctoral student in the 1980s, and partly results from her training in medical genetics, during which she logged many hours in medical genetics specialty clinics, including those involving birth defects. The most common facial birth defects are orofacial clefts, such as cleft lip and cleft palate. Orofacial clefts create feeding difficulties early in life and require numerous surgical and dental interventions, as well as speech therapy and other ongoing services. Moreover, these individuals face increased risk for mental health problems, certain types of cancer and overall, a higher mortality rate. Even since her postdoctoral years in the 1980s, Dr. Marazita has been continuously funded for her orofacial cleft research by the National Institute for Dental and Craniofacial Research (NIDCR) of the NIH. Her studies have led her to collaborations around the globe with research sites on every continent except Antarctica. Current collaborators include investigators in the Philippines, Colombia, Nigeria, Puerto Rico and various sites in the United States.

Recent new funding to support the CCDG’s orofacial cleft research includes two new grants that were received from the Gabrielle Miller Kids First Pediatric Research Initiative (GMKPI) from the Office of the NIH Director (https://commonfund.nih.gov/kidsfirst/overview). These new grants add whole genome sequencing of African and Chinese populations to previously funded research that provided sequencing of Caucasian and Latin American populations. It has been known for a long time that there are multiple genes and environmental risk factors that contribute to clefting. Only recently, though, have researchers had enough data to leverage so they can determine the source and reasons for the complexity. In fact, in spite of its complexities, many researchers are finding genes and combinations of genes that make biological sense to separate clefts into different groups and further understand the patterns of risk factors.

Improving Lives in Appalachia

In addition to orofacial cleft research, Dr. Marazita and the CCDG are engaged in research aimed at determining sources of oral health disparities in high risk, Northern Appalachian populations in West Virginia and western Pennsylvania. The goal of this project is to design effective interventions to reduce these disparities by examining genetic, environmental, behavioral, and microbiological factors and patterns of transmission within families in Appalachia in order to understand the causes of these oral health disparities. This research began in 2000, in collaboration colleagues at West Virginia University and the University of Michigan. Since those collaborations began in 2000, multiple research grants have been received by the CCDG from the NIH. The currently-funded CCDG projects focus on following the development of the dentition and onset of oral diseases in a cohort of Caucasian mother/child pairs recruited during pregnancy and followed until the child reaches at least age 6.

Furthermore, in the past year the CCDG’s Center for Oral Health Research in Appalachia (COHRA) Research Study has received additional funding from the NIDCR to recruit a cohort of African-American pregnant women—the “COHRA Smile” cohort. To gear up, we hired two new research staff (Tonya Dixon and Jill Beach) and began active recruiting in November. As of February, we have enrolled 20 moms, the first step toward developing a cohort of about 400 African-American women and their babies.” These women follow the same protocol as the original COHRA2 cohort of Caucasian women. “Periodically, they bring their children to the CCDG research suite at Bridgeside Point for evaluations that include a brief medical history, caries assessment, and sampling of saliva and plaque for DNA and microbiome analysis. Additional demographic, diet, and hygiene, and psychosocial data is collected via phone interviews. We plan to follow-up with the children at least two years old.” Our colleagues at West Virginia University, under the leadership of Dr. Daniel W. McNeil and Dr. Linda Alexander, are beginning to recruit a COHRA Smile cohort from West Virginia. We are excited about the opportunity to create the COHRA Smile cohort because it will enable further understand the patterns of risk factors.

Evaluating patients for the COHRA Smile project is Dr. Marazita (left), COHRA Smile research staff members, Tonya Dixon (left) and Jill Beach (right).

Evaluating patients for the COHRA Smile project is Dr. Marazita (left), COHRA Smile research staff members, Tonya Dixon (left) and Jill Beach (right).
Dr. Seth Weinberg led the effort to create the first web-based, public repository of normal human 3D facial images and measurements—the 3D Facial Norms Project. Studies on the genetic basis of normal-range variation in human facial features were spurred initially by phenotypic studies of orofacial clefting. As a graduate student, Dr. Weinberg helped develop protocols that Dr. Marazita and her team use to study facial shape in OFC families. Dr. Weinberg, with a background in physical anthropology, has research interests in the etiology of craniofacial birth defects, the genetic basis of human craniofacial variation, and the application of morphometrics and imaging to the study of complex craniofacial traits.

Not long after joining the School of Dental Medicine faculty in 2009, Dr. Weinberg received funding as part of the NIDCR FaceBase Consortium to investigate genetic influences on normal-range facial traits. As part of this effort, Dr. Weinberg and his team published two high-profile papers on this topic. In late 2017, in a paper published in the American Journal of Human Genetics, explored the myth that earlobe attachment is not a simple Mendelian trait, as so many of us learned in grade school. On the contrary, almost 50 regions in the genome appeared to be associated with this trait. The study also showed that many of the implicated genes are expressed in the developing human and mouse ear.

This paper, which included almost 75,000 participants, was a joint collaboration led by Dr. Weinberg. It involved numerous collaborators around the world including faculty and students in Pitt’s Department of Human Genetics, colleagues at the University of Washington, the Shanghai Institutes for Biological Sciences, University College London, and the personal genomics company 23andMe.

“We did an initial study of 2016 publications, where several novel links between genetic variants and facial measurements were identified, Dr. Weinberg and his team published two high-profile papers on this topic. In late 2017, in a paper published in the American Journal of Human Genetics, exploded the myth that earlobe attachment is not a simple Mendelian trait, as so many of us learned in grade school. On the contrary, almost 50 regions in the genome appeared to be associated with this trait. The study also showed that many of the implicated genes are expressed in the developing human and mouse ear.

This study actually started as a side project with a few third-year dental students and grew into something much bigger,” Dr. Weinberg said. “You never know where these things will lead.”

While earlobe attachment may not seem like a particularly important trait, these findings can tell us about the genes and pathways involved in normal ear development—a area where our understanding is still poor. That is relevant because the outer ear is affected in many genetic syndromes. This study can help us understand why this is the case. Moreover, it shows how even seemingly simple traits can involve incredibly complex biology.

In early 2018, Dr. Weinberg and colleagues at Pitt, Katholieke Universiteit Leuven (in Belgium), Stanford University and Penn State University published a major paper on human facial gene mapping in Nature Genetics. Using an innovative machine-learning approach to measuring the face, this work identified 15 well-replicated genetic regions associated with distinct aspects of facial morphology. Many of the implicated genes are known to be involved in craniofacial development or in syndromes where the face is affected. Moreover, the team was able to show that variants in or near these genes impact the behavior of cranial neural crest cells, which are critical for building the face during early development.

Commenting on this paper, Dr. Weinberg said, “This is probably the most work I have been involved with to date. It shows the true power of cross-disciplinary collaboration, melding together expertise in anthropology, computer science, genomics, bioinformatics, and cell biology.”

Both the 2017 and 2018 publications received wide media attention, including coverage by NPR, NBC, Popular Science, The Scientist magazine, and the Pittsburgh Post-Gazette. Despite these successes, Weinberg acknowledges that there is still much we do not know. At this time, he and his team of collaborators are working to apply their innovative approach to analysis to much larger datasets. This effort will be made possible by a recent $1.7 million R01 awarded to Dr. Weinberg and collaborator Dr. John Shaffer (secondary appointment in the Department of Oral Biology) to continue this line of investigation.
The Center for Craniofacial Regeneration (CCR) focuses on ways to restore the function and appearance of the face and skull resulting from either birth anomalies or injuries. The dynamic and innovative efforts of the CCR team hold great promise for practical use in patient treatment, extending far beyond the laboratory. A University of Pittsburgh Center of Excellence directed by Charles Stein DDS, PhD, the CCR maintains the highest standards of basic and translational research with an emphasis on teaching and training the next generation of oral and maxillofacial researchers. The CCR’s synergistic and multidisciplinary approach shared among biologists, engineers, chemists and clinicians, maximizes the potential of the research conducted by its team. In recent years, this sense of collaborative innovation has extended far beyond Pitt Dental Medicine, resulting in partnerships with researchers throughout the University, across the country and around the world.

Research studies in the CCR range from the molecular and cellular to the whole-organism level. CCR researchers focus on the development of new therapies, biomaterials, and diagnostic tools for the treatment of craniofacial diseases and disorders. Key research areas include mechanobiology, cell biology and development, tissue engineering, stem cells, biomaterials and immuno-modulation.

Highlights of a few of the CCR’s ongoing research efforts follow.

**Dentin Biology and Biomineralization**

Dr. Dobrava Napieral’s research seeks insights about how teeth and bones grow and what happens when they do not properly develop. She aims to learn more about how molecular interactions in gene regulation form dentin, the substance that makes up the majority of a tooth’s tissue. Ultimately, her research aims to gain greater insight into the physiology and pathology of dentin, as well as the regeneration and repair of skeletal and dental tissues, preserving this knowledge to make it available to the development of new therapeutics and applications. Areas she investigates include phosphorus signaling in physiologic and pathologic mineralization, molecular mechanisms of biogenesis of matrix vesicles and molecular networks of Trps1 transcription. This project examines Trps1, a protein coding gene involved in tooth development and tissue mineralization. This gene regulates the onset and progress of dentin formation. Her current work is supported by a grant from the National Institute of Dental and Craniofacial Research (NIDCR). Beyond Dentin

During tooth development, along with dentin, another tooth tissue—enamel—is formed. Enamel is the hardest tissue in our body. Initially, dentin and enamel are formed as soft tissues that gradually transform into hard tissues through the process of biomineralization. A thorough understanding of the mechanisms of craniofacial biomineralization is a necessary fundamental for developing therapies to improve human health.

“When we better understand the biology of how bone and teeth form, we can develop new therapies for these unique hard tissues by leveraging the natural processes of biomineralization,” said Elia Beniash, PhD, professor in the Pitt Dental Medicine Department of Oral Biology. Dr. Beniash’s studies of the biology of bone and other tissues impacts and influences many of the ongoing investigations at the school, especially studies in biomimetic tissue regeneration.

**Craniofacial Developmental Biology and its Impact on Diagnostic and Treatment**

The laboratory of Heather Szabo-Rogers, PhD, assistant professor at Pitt Dental Medicine, is investigating common birth defects such as oral facial clefting (cleft lip and palate) and craniosynostosis. She studies early embryonic development and uses mouse models of human diseases to better understand the molecular etiology of these conditions. In her work on cleft palate, she has found that if the road map of the cell is disrupted, and if some proteins are not in the correct place, the cells that eventually will form the lip and cranial base do not become tightly packed together in the midline. The lack of convergence predisposes the midline. The lack of convergence predisposes craniofacial anomalies.

“Deviations from this normality, as seen in the mouse, can result in the nasal septum not forming properly, “I am excited to work with the Unicorn mouse through the project that my PhD student, Brandi Lantz, is doing” she said. “The Unicorn name is perhaps a misnomer. Originally, the mouse embryos looked like they had a unicorn horn and no face, but we now have found that the mouse develops two totally separate, normal nostrils. This is an intriguing finding because we do not really know a whole lot about how the nasal septum forms.”

Dr. Szabo-Rogers sees her work being incorporated into the design of therapies that will increase bone formation during treatment of birth anomalies or injuries, as well help with diagnosis of congenital craniofacial anomalies.

**Tissue Engineering Developments**

The development of tissue engineering therapies requires collaborative effort among biologists, chemist, engineers and clinicians. The environment in the CCR fosters these collaborations, which undoubtedly will yield to novel therapies. Our interdisciplinary team takes several approaches to regenerate a tissue. One approach involves designing biocompatible materials which can initiate the regeneration of the organ. The implanted material is discarded once the organ is regenerated. This scenario has been the focus of both Dr. Alejandro Almarza and Dr. Joan Taboas. Another approach engineers cells to control the process of tissue regeneration, the focus of Dr. Fatima Syed-Picard’s research. Dr. Stein’s laboratory focuses on a third approach in which cells are recruited to the damaged tissues to repair and regenerate the tissue.

**A Scaffold Free Approach**

Dr. Fatima Syed-Picard’s research program focuses on using tissue engineering to develop devices for dental and craniofacial regenerative therapies and as controllable model systems to study basic biological processes. Her work focuses on scaffold-free tissue engineering since these biomimetic tissues closely emulate naturally formed tissues. Scaffold-free, 3D tissue engineering allows cells to generate and organize their own preferred 3D structures.
Research Technician, Dr. Juan Taboas and Chair, Herbert Ray Jr., DMD, joined by researchers priority for clinicians and researchers at the School regeneration for endodontic therapy has been a
Regenerative Therapies for Endodontic
Engineering Cellular Microenvironment
including bone, dentin-pulp complex, periodontium
match natural structures for regenerative therapies.

built microfluidic devices. These mechanisms of
on the patterning within these tissues using custom-
analyzing the effects of growth factor gradients
on the self-assembly of multi-tissue structures and
patterning in her engineered tissues. Her research
during natural development are driving tissue
is investigating whether similar mechanisms seen
with traditional tissue engineering methods. She
multi-tissue structures, a challenge that still remains
in adult, Vital-Dent. The Vital-Dent team, led by Drs.
collaborates heavily with the CCR investigators and
cells to rebuild these interfaces. The laboratory

differentiated phenotype progression of these
the lineage differentiation of stem cells and the
tools to control the cellular microenvironment and

guide tissue growth, including novel scaffolds,
tools to control the cellular microenvironment and
bioengineering with a focus on novel tissue
PhD, lie in the areas of theoretical and experimental

utilizing their endogenous matrix for structure, similar
to what occurs naturally during development. These
are additionally powerful since several types of scaffold-free constructs have been shown to self-assemble into spatially organized multtissue structures, a challenge that still remains with traditional tissue engineering methods. She is investigating whether similar mechanisms seen during natural development are driving tissue patterning in her engineered tissues. Her research group is studying the role of stem cell fate decisions on the self-assembly of multtissue structures and analyzing the effects of growth factor gradients on the patterning within these tissues using custom-built micrfluidic devices. These mechanisms of developmental biology are being applied to engineer complex tissues and organs that closely match natural structures for regenerative therapies. She is developing methods to regenerate tissues including bone, dentin-pulp complex, periodontium and the facial nerve for therapeutic use.

Engineering Cellular Microenvironment
Regenerative Therapies for Endodontic Treatments
The development of new techniques for pulp regeneration for endodontic therapy has been a priority for clinicians and researchers at the School of Dental Medicine. Department of Endodontics Chair, Herbert Ray Jr., DMD, joined by researchers in the CCR, has been testing applications of a new regenerative therapy that shows promise in improving root canal therapies. Current conventional root canal therapy involves removing the dental pulp and replacing it with gutta percha, a rubber-like material used to fill the canal that is left when diseased dental pulp is removed from the tooth. This procedure eliminates pain and infection, but leaves a devitalized tooth that cannot sense temperature, injury or infection. The tooth cannot prevent bacterial infiltration through the dentin tubules or fight reinfection without vitality. The team has been developing various biocompatible materials for pulp regeneration, including:
• a new hydrogel scaffold material developed by Dr. Juan Taboas;
• a biomimetic scaffold that involves collagen and specifically designed peptides developed by Drs. Elia Beniash and Charles Sfeir; and
• a decellularized pulp matrix developed by Dr. Charles Sfeir.

Dr. Ray says, “If we can build on and support the pulp’s innate ability to survive, we can begin to realize the potential to regenerate this tissue.” The CCR is actively working on clinical translation of an off-the-shelf implantable device to regenerate pulp in adult, Vital Dent. The Vital Dent team, led by Drs. Taboas and Ray, is comprised of several scientists, clinicians, and business advisors. “Clinical translation takes a village”, says Dr. Taboas. “We would not have seen the progress and commercial potential without the tireless enthusiasm and hard work of our student entrepreneurs”.

Skeletal Tissue Interfaces
The interface of disparate skeletal tissues is a site of mechanical failure in sport and traumatic injuries, and a challenge for regenerative medicine. Interfaces in craniofacial tissues include bone-cartilage, bone-ligament, dentin-pulp, and cartilage-tissueous tissues. The Taboas laboratory works to regenerate interfaces, with a focus on cartilage containing tissues. The laboratory has built several tools to control the cellular microenvironment and guide tissue growth, including novel scaffolds, microfluidic bio reactors, and drug delivery technologies. The hydrogels are able to control the migration, differentiation of stem cells and the differentiated phenotype progression of these cells to rebuild these interfaces. The laboratory collaborates heavily with the CCR investigators and is testing these technologies in large animal models for regeneration of bone in compromised wounds, of pulp in root canal therapy and of growth plate cartilage in the appendicular skeleton.

Natural scaffolds for TMJ Regeneration
The research interests of Dr. Alejandro Almara, PhD, lie in the areas of theoretical and experimental bone engineering with a focus on tissue engineering techniques, such as extracellular matrix (ECM) scaffolds and progenitor cells for fibrocartilage tissue engineering applications; quantification of the normal biomechanical properties and joint mechanics/motion of the temporomandibular joint (TMJ) for determining diseased states. His TMJ work seeks a solution to the loss of the mobility and abolishing discomfort associated with TMJ disorders through tissue engineering approaches. Using biologic materials composed of ECM in this manner can promote formation of functional tissue. Dr. Almara’s TMJ work aims to make ECM scaffold implantation a viable treatment for TMJ patients.

To read more about Dr. Almara’s TMJ related research, please see page 22.

Integrating Periodontal Research Through Collaboration With CCR
The efforts of the CCR research team have created a cross-pollination of sorts with the Department of Periodontics at the School. That may not come as a surprise to those familiar with the passion for research embodied by Dr. Charles Sfeir, who is both the Associate Dean for Research and the Chair of the Department of Periodontics and Preventive Dentistry. Research in periodontics applies principles that mesh well with goals of both departments and hold promise for tangible developments that will change the face of periodontal clinical care. Among these projects are studies on using magnesium devices for ridge augmentation and treatment of periodontal inflammation.

Leveraging the Immune System to Treat Periodontal Disease, CCL22, CCL2 Delivery
Dr. Steven Little is the Chairman of the Department of Chemical and Petroleum Engineering and Professor of Chemical and Petroleum Engineering, Bioengineering, Immunology, and Ophthalmology. He and Dr. Charles Sfeir share an interest in tissue engineering and their research interests complement each other very well. Dr. Sfeir is a periodontist able to understand how therapies can be applied to and benefit patients while Dr. Little provides the engineering expertise necessary to help realize many treatments.

Periodontal disease, which includes red, swollen and painful gums with bone destruction, currently is controlled through daily brushing, flossing and regular professional deep cleaning with scaling and root planning to physically remove tartar. Sometimes, antibiotics are needed to decrease the level of oral bacteria.

“Currently, we try to control the build-up of bacteria so it doesn’t trigger severe inflammation, which could potentially damage the bone and tissue that hold the teeth in place,” Dr. Sfeir said. “But that strategy doesn’t address the root cause of the problem, which is an overreaction of the immune system that causes a needlessly aggressive response to the presence of oral bacteria. There is a real need to design new approaches to treat periodontal disease.”

Together, the researchers focused on how to reestablish a healthy balance between the immune system and bacteria to manage inflammation. They have developed two strategies to design novel therapies using local drug delivery systems. The first is a microsphere system that releases a chemokine, or signaling protein, called CCL22, which attracts regulatory T cells, known to reduce and resolve inflammation. Their research revealed that when the microsphere-encapsulated CCL22...
is placed between gums and teeth affected with periodontal disease, bacterial load did not change, but the treatment led to improvements in periodontal health. Among the positive results were a decrease in pocket depth with decreased gum bleeding, indicating that there was a reduction in inflammation as a result of increasing the number of regulatory T cells.

The second approach is to use the delivery of CCL2 via microparticle polymers. CCL2 will attract a subset of macrophages that are also known to resolve inflammation. The in vivo data also shows inhibition of bone resorption due to the presence of a subset of macrophages preventing the development of the disease. The anti-inflammatory polymer microparticle that releases CCL2 offers an alternative to scaling and root planing. Mastafa Shahabaldin, a PhD student in the Pitt Dental Medicine Oral Biology program. By halting the inflammation, this approach holds promise for preventing most of the tissue destruction caused by periodontal disease. “Our approach aims at addressing the inflammatory components of the disease,” Shahabaldin said.

The long-term goal of these projects is to translate this strategy into an FDA-approved therapy that will improve patient outcomes.

**Ridge Augmentation and Resorbable Metals**

Ridge augmentation reshapes the jaw and gums to restore their natural contour. This procedure often is needed when bone loss in the jaw happens after tooth extraction. The magnesium device-based ridge augmentation being developed at the Pitt Dental Medicine has a number of advantages that set it apart from current clinical options, such as fewer complications after surgery, increased stability for larger augmentations and elimination of the need for a second surgery, according to Dr. Pratiksha Amin, a second-year periodontics resident. Magnesium-based periodontal membranes and scaffolds address an unmet clinical need by providing mechanically stable yet resorbable devices, said Dr. Kelly Williams, Periodontics Residency Program Director.

“This would provide a safer, more predictable option for ridge augmentations,” Dr. Amin said. The mechanical properties of magnesium, she added, closely match those of bone, and safely breakdown in the human body.

During in vitro studies, Dr. Amin explains that exposing cells to magnesium promotes rapid reproduction and expression of bone-producing markers. When the devices are placed surgically in vivo over the grafted area, they hold the graft in place until it turns over to bone, she said. Once their job is complete, the devices degrade through a process called biocorrosion, eliminating the need for surgery to remove any metallic devices.

“Hopefully, many commercially available products will come out of this such as magnesium resorbable membranes, fixation screws, and digitally-designed and 3-D printed membranes, to name a few,” Dr. Amin said.
HOME TO NATIONAL RESOURCE CENTER TO SUPPORT TRANSLATIONAL RESEARCH

There is an abundance of resources available at Pitt Dental Medicine and the University of Pittsburgh to facilitate activities in translational research areas. Such easy availability is seen at only a handful of institutions. These resources include guidance with clinical studies, intellectual property regulations and collaboration across multiple specialties throughout the University, especially with the McGowan Institute for Regenerative Medicine.

At the Center for Craniofacial Regeneration, the necessary infrastructure is present to carry out pre-clinical studies for FDA submissions following general laboratory practices (GLP). These quality systems of management controls for research ensure uniformity, consistency, reliability, reproducibility, quality and integrity of pre-clinical experiments.

At the heart of Pitt Dental Medicine translational efforts is the Michigan-Pittsburgh-Wyss Resource Center (MPWRM): Supporting Regenerative Medicine in Dental, Oral and Craniofacial Technologies. This center, which brings Pitt Dental Medicine together with University of Michigan and Harvard University researchers, was created through the National Institute for Dental and Craniofacial Research’s (NIDCR) Dental Oral and Craniofacial Tissue Regeneration Consortium (DOCTRC) initiative. The Pitt collaboration is one of only two national resource centers established through this NIDCR effort. Designed to move clinical trial-ready projects along the translational pathway, the MPWRM supports promising craniofacial, dental and oral health technologies through its Interdisciplinary Translational Projects (ITP) program. Principal investigators at Pitt are Dr. Charles Stein and Dr. William Wagner, Ph.D., director of the McGowan Institute for Regenerative Medicine. Drs. David Kahn and William Giannobile serve as the principal investigators at the University of Michigan. At the Harvard-based Wyss Institute, Dr. David Mooney serves as the principal investigator.

Services and resources that this center provides are designed to give cutting edge developments the support that meet their needs. Services offered by the resource center include commercialization, intellectual property rights, manufacturing, marketing, regulatory affairs, quality control and data management—all areas vital to moving a project along the translational pathway and essential for, ultimately, getting them to patients. By creating an infrastructure that supports a project’s progress through the regulatory process and clinical trials, the resource center offers a unique opportunity for some of the most promising dental, oral and craniofacial technologies in development today.

This center stands poised to bring an emerging field into prominence by supporting the biotechnological efforts of the most promising investigators in clinical-translational dental research. The promise of this center encompasses advances in a range of areas, from dental to craniofacial to oral, offering practical solutions for those performing cutting edge research. One of the key ways the resource center achieves that is by pairing the selected ITP projects with those who have the needed clinical, science, industrial and regulatory experience to move a project from the research to the clinical trial phase. The MPWRM has now selected 10 cutting edge therapies to usher into clinical practice. A significant number of these projects are at Pitt or have Pitt connections, demonstrating the vitality of our research.

Consortium-Funded projects at Pitt Dental Medicine

ECM Scaffold for TMJ Disc Repair
Alex Almaraz, PhD, University of Pittsburgh

This technology involves a scaffold composed of extracellular matrix to effectively induce the novel formation of new, hard-derived, functional tissue for replacement of the temporomandibular joint. This therapy offers a solution to the problem of temporomandibular joint replacement, which, currently, rarely occurs because of the lack of alloplastic products available and the rapid resorption rates of autologous tissue replacements. For more information please see story on page 22.

Controlled Released System for Immunoregulation and Treatment of Periodontal Disease
Steven Little, PhD, University of Pittsburgh

These next generation treatments mimic the body’s natural immune regulation mechanisms and employ natural, endogenous cells as agents of periodontal disease treatment. This therapy has the potential to significantly impact how periodontal disease is treated clinically by addressing chronic inflammatory response, which has ultimately been found to be responsible for tissue destruction in periodontal disease. For more information, please see the periodontal research section on page 14.

Bioabsorbable Magnesium/PLGA Barrier Membranes
Stephen LeBeau, PhD, nanoMAG, LLC

This Pitt SDM technology, using nanoMAG materials, addresses the need for a form-stable, fully resorbable barrier membrane. By incorporating the nanoMAG BioMg magnesium alloy, this technology adds structural reinforcement to the barrier membrane by remaining fully resorbable. Such a material could produce more reliable outcomes by increasing bone regeneration, supporting soft tissue healing and eliminating device removal procedures. For more information please see the periodontal research section on page 14.

Cryopreserving Adipose Tissue Grafts
Peter Rubin, MD, University of Pittsburgh

This project addresses the need for preserving fat tissue for use in difficult-to-access soft tissue and volume/contour deformities arising from craniofacial trauma, congenital anomalies and cancer treatment. By making fat preservation accessible, this technology will offer an alternative to current treatment options, which pose problems such as expense, degradation, complication risk, long-term inflammation and displacement.

Stakeholders’ Summit

On July 10 and 11, 2018, the MPWRM Resource Center’s first stakeholders’ summit will happen in Pittsburgh. Featuring investigator training and programs on doctoral, oral and craniofacial technologies, this event will bring together MPWRM, ITP awardees and industry to focus on this innovative field. Evaluation results of a second round of ITP funding will also be reviewed at the summit.

For more information on the MPWRM, visit https://doctr.pitt.edu

But clinical research also includes:
• discoveries in the research laboratory or in preclinical studies that will have an impact on human health and may lead to the development of new treatments for humans;
• the process of applying discoveries generated during research in the laboratory, and in preclinical studies, to the development of trials and studies in humans;
• research aimed at enhancing the adoption of best practices in the community; and
• cost-effectiveness of prevention and treatment strategies is also an important part of translational science.

Clinical research is usually defined as research with human subjects that is:
• patient-oriented research; and
• epidemiologic and behavioral studies, and
• outcomes research and health services research.
In 2018, temporomandibular joint (TMJ) dysfunction is a common occurrence. Although performing a full replacement is a trusted and effective option, there are many patients who exist along a TMJ spectrum; not quite needing a full replacement, but struggling with discomfort. For many of these patients, a simpler disk replacement could improve quality of life. However, for years, a safe and effective replacement product has been out of reach.

During the 1980s, surgeons were using a Proplast Teflon implant to replace the TMJ disk. However, the FDA soon banned this material when it became apparent that, for a subset of patients with the implant, the disk was causing erosion of the skull, ultimately endangering the patient’s brain. Since then, the FDA has classified most TMJ devices as Class 3, a designation that indicates the highest level of complexity. Considered to carry the greatest risk to the patient, these devices demand the most stringent regulations in order to verify that they are both safe and effective.

The intensity of the FDA requirements has presented a special challenge for doctors seeking to innovate in this highly specialized field. However, that has not deterred a passionate team of doctors and researchers in our own backyard from pushing forward. For the past eight years, Dr. William Chung and Dr. Alejandro Jose Almarza have been integral members of a team from the Pitt School of Dental Medicine who are working towards FDA approval of a TMJ disk replacement implant.

After performing the trial implant surgeries at Cornell, the team used non-invasive MRIs to monitor the position of the implants for six months and determine whether they were remodeling as intended. According to the data collected during this phase, the properties of the remodeled tissues fully matched those of the native tissues in compression and matched at least half of the properties of the native tissues in tension. Never before have results for a manufactured TMJ insert looked so promising.

Despite incredible strides forward, the team understands that the challenges are far from over. One of the fundamental inhibitors of progress is the fact that not all TMJ surgeons agree on how to address the same patient. Because of this, it can be difficult to rally unanimous support for a single new implant or procedure. However, based on their findings thus far, Dr. Chung believes, “It’s a no-brainer. We’d be doing patients a disservice not to pursue this device in humans.”

Dr. Almarza echoes this passion, saying, “It gets us up in the morning, knowing that the patient will be better for it.” Although some may still require the full TMJ replacement later on, the implant could help others avoid this procedure altogether. Either way, the implant offers patients greater comfort and long-term mobility than any other options currently available.

In the past 18 months, the doctors secured a FDA-certified biomedical company, Cook Biotech, to manufacture the implant—a key step toward receiving approval for human trials from the FDA. The team plans to begin the last round of trial surgeries at Cornell with this high-quality device later this year. If all goes as expected, the final trial surgeries and data analysis should be complete during the summer of 2019, at which point, they would be ready to re-submit their data and results to the FDA. If approved to begin human trials, the first surgeries would be performed on 10 patients in Pittsburgh. Once deemed to be safe and effective in those cases, the team plans to enlist three other universities to recruit 100 of their own patients to carry out the trials. Provided that there are no complications during this phase, the team would have a very strong case for FDA approval of their device for use in the general public.

Of course, at the heart of their research mission is the desire to better serve each patient that walks through the door. This journey has been a labor of love, and one that would not be possible if Dr. Chung, Dr. Almarza and their team did not fully believe in the potential benefit this procedure could provide.

After eight years, the doctors are poised to translate their research into human trials and publish their findings with the support of funding from the Pittsburgh-Michigan-Wyss Consortium. This specific approach to the TMJ disk is the first of its kind, and the combined announcement of these developments could set Pittsburgh apart as a leader in TMJ research, not just in the country, but around the world.

TMJ Anatomy

The temporomandibular joint (TMJ) is the joint that connects the jaw to the skull. More specifically, the TMJ permits articulation of the condyle of the mandible with the temporal bone. In between the condyle and the temporal bone is the meniscus, sometimes referred to as the TMJ disk. When functioning properly, a healthy TMJ allows for easy, pain-free chewing and talking. However, a variety of factors including age, injury and autoimmune diseases can cause the meniscus to become thin and the TMJ to no longer function as it should. Without the necessary cushion that the fibrous disk provides, the joint is forced to articulate bare-bone-on-bone. This can cause pain not only in the jaw, but in the neck, ears and head, in the form of a migraine. Given the pivotal role that proper jaw function plays in nourishment, communication and overall quality of life, many patients require surgery in order to regain TMJ mobility and decrease what can often be debilitating discomfort.
Leveraging a Mature DRDR

Today, there are more than 6,000 participants on the DRDR registry, which grows at the rate of roughly 400-600 new entries every year. With this large and growing number of DNA samples, Dr. Vieira is able to ask more sophisticated questions and obtain more comprehensive medical records—understanding each person as a whole. Although an ambitious concept, the DRDR allows researchers to evaluate issues of best practice and seek to understand if there are better ways to perform certain treatments.

One recent question involved looking into the correlation between mental health and common dental procedures such as fillings and root canals. What Dr. Vieira found was that while poor mental health had no impact on the success of amalgam fillings, it did greatly increase the potential for failed root canals or composite resin fillings. This offers a prime example of the relevance of these questions. If a patient with a mental health concern goes to the dentist and the dentist does not consider these risks, the patient might not receive the results they desire.

One of the greatest strengths of the DRDR is its ability to be used by other researchers and teams seeking to mine questions more specific to their unique disciplines.

Growing the Future of the DRDR

For the past twelve years, the DRDR is the only project in the world to collect and maintain DNA samples for the purpose of long-term research related to oral health. As a result, researchers around the globe have become increasingly interested in understanding Dr. Vieira’s approach. One of the most visible signs of enthusiasm for the project comes from Puerto Rico, where researchers are in the process of opening their own version of the DRDR. Although the Puerto Rico team has not yet determined whether they will seek Dr. Vieira’s assistance for organizing their data, theirs is the most concrete step in the direction of replicating the DRDR model.

While Dr. Vieira and his primarily junior team have made incredible breakthroughs in understanding the root causes behind common dental issues, the project has merely scratched the surface of what is possible. The results from the evaluation of mental health’s role in dental treatments and collaborations such as that with the orthodontics department illuminate not just how the DRDR can shed light on issues of oral health, but on conditions throughout the body.

Ultimately, the research conducted by the DRDR can provide dentists with a greater degree of knowledge on the less-understood impact of genetics. This insight allows medical professionals to broaden their perspective on the root causes of disease and seek innovative changes in procedures that can positively impact the delivery and success of care.
Evidence-based practice is an important theme within the department’s research and teaching mission. Evidence-based practice is grounded in a belief that when a dentist is informed by the current best evidence of “what works” and uses that information as part of a treatment planning process with the patient, that will result in the best chance for optimal patient outcomes. Thus, at the heart of evidence-based teaching is the notion that each dentist should master the skills to efficiently search clinically relevant evidence, evaluate its quality and implement it in patient care. Beyond individual efforts, evidence-base practice also emphasizes changes to the actual structure of how clinical care is delivered. Identifying and addressing organizational and structural barriers to the provision of care based on current best evidence is the domain of translational research.

Departmental faculty member Dr. Deborah Polk, focus her research interests on this area and was recently awarded a National Institutes of Health (NIH) UO1 grant to identify the best way to influence dentists’ clinical behavior through system-level changes. The importance of this research, states Dr. Weyant, is that it will “advance care delivery in ways that will improve both patient and population health.”

A recent example of how new evidence can be used to improve patient care was a case involving a patient who requested new dentures. Due to a hyper-responsive gag reflex, the patient was unable to tolerate any stimulation to the palate. The patient had been struggling to wear his current denture which was ill-fitting due to his difficulty tolerating the denture impression process. As Dr. Sarah Grafton, assistant professor of operative dentistry, explains, “the student researched a technique utilizing removable training plates of increasing thickness to effectively ‘train’ the patient to tolerate palatal stimulation for specified time intervals.” The technique was published online in The Cochrane Library.

By searching for an approach that would be more tolerable for the patient, evaluating the quality of the evidence attesting to its potential success and implementing the procedure, the student was able to conduct a successful impression, allowing new dentures to be made. According to Dr. Grafton, this same method used to make a successful impression allowed the patient to tolerate the new dentures, “within a period of about 6 months.” One year later, the patient continues successfully to wear his new dentures. This is an excellent example of how challenging patient care situations can be addressed through accessing and applying high quality evidence.

The Department of Dental Public Health in collaboration with the Department of Pediatric Dentistry also manages a federal Health Resources and Services Administration training grant aimed at training pediatric dentistry residents in care to high risk, low access population such as commonly found in rural Pennsylvania. The training grant also supports the residents for completion of a Master’s in Public Health degree. As he looks to the future, Dr. Weyant anticipates that the Department of Dental Public Health will continue its tradition of high quality teaching and research in support of the School of Dental Medicine’s overall mission.
Digital Dentistry and 3D Technology

FABRICATING THE FUTURE OF DENTISTRY

3D printing may seem mysterious, futuristic, the stuff of sci-fi. But many industries are employing the technology here and now to develop products, customize parts and products, and reduce manufacturing time and cost. Aerospace companies, medicine, even sneaker manufacturers—entire fields are evolving due to 3D printing.

Dentistry is no exception. Faculty at the University of Pittsburgh School of Dental Medicine are actively exploring ways that digital technology and 3D printing can improve outcomes in dental treatment, lower costs and increase patient satisfaction. Among the groundbreaking developments is a collaborative research project between Pitt Dental Medicine and Swanson School of Engineering that may “fabricate” the future of dentistry.

The research partners propose a new way: taking digital images of a patient’s mouth; using AI algorithms and computer programming to design a denture framework; then 3D printing the product...

Research partners John Ference, DMD, MPH, a prosthodontist and assistant professor at Pitt Dental Medicine, and Markus Chmielus, PhD, an assistant professor in the University of Pittsburgh Department of Mechanical Engineering and Materials Science, are using additive manufacturing (AM, a 3D printing method) and generative design (the use of computer software and artificial intelligence [AI]) to create and test denture frameworks. AM uses computer-aided design and manufacturing (CAD/CAM) to rapidly produce a prototype and then accurately build materials to fabricate a complex structure tailored to a specific patient.

Using additive manufacturing, these partnering Pitt faculty hope to make stronger products with more accurate fit at lower cost using a method that is radically different from traditional subtractive techniques.

“We still fabricate dentures the same way we’ve been doing it for 20 years or more,” Dr. Ference said. “Traditional methods of fabrication require numerous steps that include impression making, model fabrication, transporting models back and forth to the dental laboratory, casting metal, adding porcelain, finishing, polishing and storage of casts. Every step in the fabrication process requires a thorough understanding of the coefficient of thermal expansion and manipulation of materials to avoid ill-fitting prostheses. Whether it is contraction of impression materials, expansion of gypsum, the contraction of molten metal or zirconia, contraction of dental polymers—good technique dictates success or failure. Digital scanning and fabrication methods eliminate many of the changes metals, porcelain, and impression materials undergo.”

Dr. Chmielus agrees that the established method leaves much potential for error. “A metal partial dental framework normally gets cast from an imprint using a gummy material in your mouth, then they cast another shape, and then out of that shape, they produce the metal framework,” he said. “It is a fairly complex method and not extremely accurate because it getsiggled around to be removed from the patient’s mouth, then they can alter another shape, and then another. There are a lot of steps involved where errors can be introduced.”

The research partners propose a new way: taking digital images of a patient’s mouth; using AI algorithms and computer programming to design a denture framework; then 3D printing the product by selectively binding a powder together with a glue, layer by layer, then removing that glue.

They did exactly that for an in vivo proof-of-concept study recently published in the Journal of Additive Manufacturing. Their team compared the mechanical and physical properties of a 3D-printed framework (made of Inconel 625 metal alloy) with traditionally manufactured frameworks. They tested for specific gravity, tensile strength, elongation, compressive strength, thermal strength, impact, and coefficient of linear thermal expansion—and found that the physical and mechanical properties of their denture were very similar.

Their work has been recognized by the American Dental Education Association (ADEA), which awarded Pitt Dental Medicine and Dr. Ference the 2016 ADEA/Gies Award for Outstanding Innovation by an Academic Dental Institution. The findings have been presented to an engineering audience at the Materials Science and Technology 2017 conference, and Dr. Ference is preparing to submit the work to the American College of Prosthodontics and the Journal of Prosthetic Dentistry.

“We’ve shown we can print these. They have very good structure, good strength, comparable dimensions,” Dr. Chmielus said. “The next step is to move toward the patient, use dental scanning capabilities, make a digital model of the denture framework of the implant, then print it.” Ultimately, Dr. Ference and Chmielus aim to create a denture framework out of a biocompatible material, test the mechanical properties and dimensional properties again with that new material, then print and place the dentures in patients. To facilitate the next stage, they recently submitted a request for funding from the National Institutes of Health (NIH) to cover materials and an engineering PhD student to work full-time on the research. They eventually hope to obtain approval from the University of Pittsburgh Institutional Review Board to conduct a pilot study in the School of Dental Medicine.

The Big Picture

“I think this is going to shake up the profession,” Dr. Ference said. “The future dental professional must be able to use a hand-held or cone-beam tomography scanner to create digital scans of a patient requiring a prosthesis, modify and digitally design it, fabricate it by printing, and deliver and adjust the prosthesis before the patient leaves the operatory.”

“I think this is going to shake up the profession”

—Dr. John Ference

Potential benefits for patients are fourfold: The new method stands to save them time, reduce costs, reduce the weight of prostheses, and improve fit. Rather than scheduling and enduring six visits over time, patients would be scanned one day and have the prosthesis the next, as the process takes several hours rather than several days. Practitioners could use less expensive materials and would go through fewer steps to both acquire a model and to make a denture framework. Prostheses would be much stronger and longer lasting, requiring fewer replacement. And even when replacements would be necessary, digital models would already be on file for reproduction.

“To meet the growing expectations and patient demands in the United States will require dental professionals to make prostheses faster, use materials that are less expensive, lighter weight...
How Does Dentistry Get There?

The future is promising, but challenges and work lie ahead. Dr. Ference said the biggest hurdle is that academics in general tend to be cautious about how and when they embrace innovation. “Dentistry is never going to be entirely digital because it is something you do with your hands. And we don’t want to be entirely digital,” Dr. Erdle said. “But it is a great tool to have in the toolbox.” He hopes the school and its faculty can be “cautiously creative—giving students and residents time to play a little bit to see how they can use the technology in a new and innovative way, than run with it responsibly.”

Dr. Juan Taboas, PhD, a researcher in the School of Dental Medicine, emphasizes the word responsibly. He is working to develop hydrogel scaffolds to study intracellular signaling, cell-to-cell communication, and tissue growth, and he aims to someday use 3D printing to create the scaffolds. Although he also is excited about the potential of digital and 3D technology in many facets of dentistry, he cautions the industry to make sure that any advancements are evidence based. “Dentistry never being to entirely digital because it is something you do with your hands. And we don’t want to be entirely digital,” Dr. Erdle said. “But it is a great tool to have in the toolbox.”

He stressed the importance of evidence-based practice and comparative effectiveness research whenever dentistry implements such technology, as well as the importance of educating students along the way. “Some of the students have played with 3D printers in their garages. It is not a difficult technology to comprehend,” he said. But there is more to it than that. “We have to revamp our materials courses so they understand the limitations, how materials shrink as they are built layer by layer, how they shrink more between layers than within layers. Students need to understand why this happens and what to look for to choose the best materials. And they need a digital design background. They have one cursory exposure now. They need to develop experience with the software, how to draw on the computer.”

Dr. Ference imagines a future where dentists who have such training can take images of a patient, digitally design the necessary product, then head to a local, large printing lab with very sophisticated and expensive equipment for accurate, cost-effective production.

Education together with Collaboration Leads to Meaningful Creation

Pitt Dental Medicine’s four-year dentistry program is designed to comply with the guidelines set forth by the Commission on Dental Accreditation (CODA). The curriculum is designed to educate students to take their places among the best dental practitioners, researchers and educators in the region, across the country, and even around the world. The school’s leaders are actively seeking ways to continue success in those areas while also training dentists in digital dentistry and 3D printing.

“Changes in the curriculum have been happening, and there’s an understanding of the need for further change in the curriculum,” Dr. Ference said. “Administrators are open to those ideas. They know it’s necessary if they want to be competitive.”

He suggests expanding upon existing collaborations between the schools and departments right here at Pitt. In the same way dental students can concurrently pursue a master’s of public health degree or a business degree through the Graduate School of Public Health or the Joseph M. Katz Graduate School of Business, perhaps future students can simultaneously complete their dental training and earn a master’s degree in dental technology or a master’s in dental materials through a collaboration with the Swanson School of Engineering.

“Over the past decade, health care has taken on an interdisciplinary approach to making patients healthier. Before that time, each discipline tended to act independently of other health sciences. For example, the engineering school, dental school, and medical school would be distinct silos of information,” he said. “But we’re now strongly rooted in collaboration and integration of everything we do—getting a lot of specialties involved, together, to improve treatments for all of our patients.”

Sources


30 UNIVERSITY OF PITTSBURGH SCHOOL OF DENTAL MEDICINE EIGHTEENTH ANNUAL RESEARCH SYMPOSIUM 31
RESEARCH CLUSTERS

**Center for Craniofacial and Dental Genetics**

Genetics plays an increasingly critical role in modern biomedical science and clinical practice, including dental and craniofacial sciences. The University of Pittsburgh historically has been a leader in genetics, developing one of the first Departments of Human Genetics in the nation. Within the School of Dental Medicine, this tradition is embodied in the Center for Craniofacial and Dental Genetics (CCDG), which was established as a University Research Center of Excellence in 2001. Research at the CCDG is primarily focused on understanding the etiological basis of complex oral and craniofacial traits, notably dental caries and orofacial clefting, with an emphasis on genomic and phenotypic analyses.

Led by the Director, Dr. Mary L. Marazita, the CCDG currently comprises 4 faculty (plus 8 additional affiliated faculty), 28 staff, and 15 students and post-doctoral fellows. CCDG faculty have expertise in statistical genetics, molecular genetics, computational modeling, morphometrics, and imaging. The Center has had continuous National Institutes of Health funding since its establishment, currently about $5 million annually.

**CCDG Faculty**

- Mary L. Marazita, BS, PhD, Professor
- Katherine Neiswanger, BA, MA, PhD, Research Associate Professor
- Petr Pancoska, BS, PhD, Research Associate Professor
- Seth M. Weinberg, BA, MA, PhD, Associate Professor

**Center for Craniofacial Regeneration**

The Center for Craniofacial Regeneration (CCR) is dedicated to the development of technologies and clinical therapies for craniofacial repair and regeneration. This University of Pittsburgh Center of Excellence is a global leader in this rapidly developing field. Our strength lies in the synergistic approach to translational research by clinicians, engineers, and basic scientists. Our vibrant intellectual environment is committed to the academic excellence and career development of faculty, clinicians, postdocs, fellows, graduate and undergraduate students, and visiting scholars.

The expertise of our cell and molecular biologists, developmental biologists, polymer chemists, material scientists, bioengineers, and clinicians allows the innovative employment of therapeutic systems from the molecular to the tissue level. To meet these challenges, the CCR strives to foster multidisciplinary approaches to regenerate mineralized, temporomandibular joints, and soft tissues of craniofacial structures. To this end, we employ tissue-engineered strategies such as cellular therapies, biomaterials and mechanobiology.

Our innovation Center members have developed new and unique technologies leading to licensing agreements and startup company developments.

**CCR Faculty**

- Charles Sfeir, DDS, PhD, Associate Professor, Associate Dean for Research
- Alejandro Almarza, PhD, Associate Professor
- Elia Beniash, PhD, Professor
- Ballav Moni Borah, Visiting Research Associate
- Andrew Brown, PhD, Clinical Assistant Professor
- BJ Castello, DMD, MD, Professor and Dean
- Jin Gao, PhD, Research Assistant Professor
- T Jayaraman, MS, PhD, Assistant Professor
- Kai Liu, MD, PhD, Research Associate
- Dobrawa Napierala, PhD, Associate Professor
- Herbert L. Ray Jr., DMD, Assistant Professor
- Sayuri Smith, DDS, PhD, DMD, Assistant Professor
- Fatima Syed-Picard, MSE, PhD, Assistant Professor
- Heather Szabo-Rogers, PhD, Assistant Professor
- Juan Taboas, MS, PhD, Assistant Professor
- Kostantinos Verdelis, DDS, PhD, Assistant Professor
- Alejandro Vieira, DDS, MS, PhD, Professor
- Hajime Yamazaki, PhD, Research Assistant Professor
- Samer Zaky, PhD, NDB, DMD, Research Assistant Professor
Dental Public Health

Through a variety of research, teaching and outreach initiatives, the Department of Dental Public Health advances its primary mission of “improving population oral health.” The various domains of mission-related activities include the following:

- Conducting research aimed at identifying and reducing oral health disparities;
- Preparing students for non-traditional careers in academics, public health, and other areas of importance to society;
- Implementing evidence-based practice in patient care;
- Advancing methodology for the study of population health issues of relevance to dentistry;
- Advocacy and policy development aimed at improving access to dental care; and
- Advancing service learning and interprofessional education.

Department Faculty

Robert Wayant, MS, DMD, DrPH
Professor
Chair
Associate Dean for Dental Public Health and Community Outreach

Joseph Ambrosino, BS, MS, MPH, DMD, FAGD
Instructor

Jacqueline Burgette, DMD, PhD
Assistant Professor

Zsuzsa Horvath, PhD
Assistant Professor

Anchal Malik, BDS, MHSA
Assistant Professor

Nina Markovic, BSDH, MS, PhD
Associate Professor

Paul Moore, BS, DMD, MS, PhD, MPH
Professor

Louise Platt, RDH, BSDH, MHPE
Instructor

Deborah Polk, AB, PhD
Assistant Professor

Richard Rubin, BA, DDS, MPH
Assistant Professor

Nilesh Shah, PhD
Assistant Professor

The Dental Registry and DNA Repository (DRDR) was created in response to the need for large sample populations to act as a resource to researchers of complex oral diseases and conditions. The interplay between the host, its genetic background and the environment, where each component has a relatively small effect size, suggests that studies need to be robust and sample sizes should be in the magnitude of several hundreds, if not thousands, of observations.

The DRDR is an archive of clinical information linked to saliva samples from consenting individuals. Participants include both children and adults who have received treatment at the University of Pittsburgh School of Dental Medicine. Currently, approximately 6,200 subjects are part of the DRDR database, which is available to faculty and students for the development of clinical research projects.

The registry has supported several faculty and student projects, and more than 20 scientific papers and grants have been generated with this resource.

Dental Registry and DNA Repository Faculty

Alexandre R. Vieira, DDS, MS, PhD
Professor
Director of Clinical Research and Student Research of the School of Dental Medicine

Dental Registry and DNA Repository Faculty

Deborah Polk, AB, PhD
Assistant Professor

Richard Rubin, BA, DDS, MPH
Assistant Professor

Nilesh Shah, PhD
Assistant Professor
Dental Anesthesiology

The Department of Dental Anesthesiology is extremely active in teaching, research, and service. The department operates a 3-year dental anesthesiology residency program and is a training site for the School of Nursing’s Student Nurse Anesthetist program. Together, these residents, nurses, and our own selective dental students enable the department to provide clinical anesthesia services in the oral surgery, implant, phobia, pediatric, and special needs areas. The department maintains some of the most sophisticated equipment found in any dental school setting. This includes nine anesthesia machines, three fiberoptic videolaryngoscopes, and three videolaryngoscopes.

- Predoctoral teaching includes courses in local anesthesia, medical emergencies, pain and anxiety control, enteral sedation, and clinical medicine. The medical emergency management is accomplished at the University of Pittsburgh’s Peter M. Winter Institute for Simulation, Education, and Research (WISE) Center, where students are assessed as they manage various office emergencies in real time using high-fidelity human simulators.

- Department of Dental Anesthesiology faculty are involved in continuing education for the School of Dental Medicine, teaching courses in local anesthesia for dental hygienists, medical emergencies, and a 15-hour course in basic and advanced anesthesia management and simulation for licensure and permit renewal. In addition to these many activities and responsibilities, departmental faculty are actively engaged with many school-related committees while pursuing research and publication objectives.

- Dental Anesthesiology Residency Program
  - The department operates a three-year, CODA-accredited, hospital-based dental anesthesiology residency program. The goal of this program is to prepare dentists to manage pain and anxiety in adult, pediatric, and special needs patients.
  - Graduates receive a Certificate in Dental Anesthesiology and are eligible to take the board examination of the American Dental Board of Anesthesiology.
  - All residents must be graduates of an accredited U.S. or Canadian dental school. The application is submitted through the ADEA Postdoctoral Application Support Service (ADEA PASS) website and the deadline for submission is September 15 of each year.

Graduates are required to take part in the American Board of Endodontics examination. When the program ends, all residents will be awarded a certificate in endodontics and be considered board-eligible.

Research Focus
- Pulp regeneration using scaffolds and growth factors
- Pulp regeneration using cellular approaches
- Understanding root anatomy through high-resolution micro-CT imaging
- Industry collaborations to assess and improve endodontic files
- Effectiveness of instrument systems to deliver disinfecting agents into the root canal

Endodontics

Certificate in Endodontics with Optional MDS

Graduates are required to take part in the American Board of Endodontics examination. When the program ends, all residents will be awarded a certificate in endodontics and be considered board-eligible.

Research Focus
- Pulp regeneration using scaffolds and growth factors
- Pulp regeneration using cellular approaches
- Understanding root anatomy through high-resolution micro-CT imaging
- Industry collaborations to assess and improve endodontic files
- Effectiveness of instrument systems to deliver disinfecting agents into the root canal

Clinical Training
- Treatment management, including surgery of diseases of the dental pulp and periapex, and trauma of the tooth root and pulp

Criteria
- Applicants must hold a DMD from a CODA-recognized dental school or its equivalent.
- Applications are acceptedMay–August of each year.
- Applications are accepted May–August of each year.
- Admissions are conducted using a rolling format.

Department of Dental Public Health

The Department of Dental Public Health provides high-quality education to first-professional dental students and residents, conducts scholarly research that advances knowledge in dentistry, and acts as a resource service unit not only within the School of Dental Medicine, but also to other areas throughout the University and surrounding community. Departmental faculty members engage in a variety of funded and non-funded basic, clinical, and population-based research. Research productivity is substantial and many faculty play leadership roles in local or national research organizations. Our faculty are working on important new methods for designing and analyzing dental data and advancing dental research. The department currently is part of a large National Institutes of Health (NIH)-funded project on the causes and elimination of oral health disparities in Appalachian children and their families. A theme of understanding the causes of oral disease and developing effective interventions for vulnerable and underserved populations runs through much of the department’s research activities. The department maintains active research collaborations with the University of Pittsburgh Cancer Institute (UPCI), Magee-Womens Hospital, the Clinical and Translational Science Institute (CTSI), and numerous other research universities in the United States and abroad.

Diagnostic Sciences

Certificate in Diagnostic Sciences

The Department of Diagnostic Sciences in the School of Dental Medicine is responsible for the areas of oral radiology, oral medicine, oral pathology, and dental emergency medicine. The department has faculty that have achieved diplomate status ("boarded") in their specialties of oral medicine, oral and maxillofacial pathology, and oral and maxillofacial radiology, indicating their experience and expertise in their fields. All faculty teach pre-doctoral students, dental hygiene students, and residents either in clinical rotations or in foundational and clinical didactic courses, and provide continuing education to dentists, hygienists, and physicians. The department hosts a three-year residency program in oral and maxillofacial pathology and houses a biopsy laboratory. The department has hosted several summer research scholars and participants in resident research projects. In addition, faculty have their own research areas of interest. Recent, current, and future projects include determining the oral electronic record to assess treatment disparities of disadvantaged patients, quality assessment outcomes of consultative recommendations, genetic mutations in odontogenic tumors, cancer chemoprevention using lyophilized fruits, comparative radiographic features of salivary gland neoplasms; demographics and outcomes of the biopsy service, and demographics and outcomes of the oral medicine clinical practice.

Clinical Training
- Treatment management, including surgery of diseases of the dental pulp and periapex, and trauma of the tooth root and pulp
- Applicants must hold a DMD from a CODA-recognized dental school or its equivalent.
- Applications are accepted May–August of each year.
- Admissions are conducted using a rolling format.

The Department of Oral and Maxillofacial Surgery (OMS) at the University of Pittsburgh offers a six-year, dual-degree program and a four-year program. These residents are accepted each year as well as one pediatric craniofacial fellow.
Meet Our Students

Meet Ahmed's research project focuses on two areas: designing scaffold-free tissue engineered biomimetic nerve conduits to bridge nerve gaps, and developing cellular therapies to enhance current methods of nerve regeneration therapies using dental pulp stem cells. The current gold standard for treating peripheral nerve injuries involves autografts; however, there is limited graft availability, treatment requires long recovery times and the restoration of full nerve function is not achieved. Due to their neural crest origins, dental pulp stem/progenitor cells (DPSC) have a high potency for differentiating into neuronal cells. Mr. Ahmed has presented his work at the McGowan Institute for Regenerative Medicine Annual Retreat in March 2018.

Rasha Alotaibi's studies focus on the understanding of susceptibility to dental caries in a large multiethnic population, originally recruited for studies of dental clasts by conducting a genome-wide association study (GWAS). She recently became involved in genetic analyses of different dental anomalies, including tooth agenesis and hypoplasia, among subjects with craniofacial clasts. Mr. Alotaibi was selected to give an oral presentation at the 96th IADR/PER General Session & Exhibition, London, England, July 2018.

Qahtan AlQahtani focuses on the development of pulp regeneration therapies using decellularized dental pulp matrices. He is working on understanding cell-matrix interactions, utilizing dental pulp and periodontal ligaments cells. This work also encompasses the studies of host response to dental pulp matrix and matrix turnover, using bone marrow derived macrophages. His work was presented at the Pitt Dental Medicine Seventeenth Annual Research Symposium in 2017.

Mariana Bezamad studies phenomics, an area of biology concerned with the measurement of phenomes (the set of physical and biochemical traits belonging to a given organism) as they change in response to genetic mutation and environmental influences. In her project, Ms. Bezamad will test how oral health outcomes and overall health comorbidities of individuals that survived cancer are affected by genetic variation to define disease patterns that associate with specific genomic profiles.

Ahmed El Sergani's project focuses on the regeneration of cartilaginous surfaces in the temporomandibular joint (TMJ). He studies cartilaginous tissue interfaces and the effects of gradients of biologically active molecules on different cell populations.

Brandi Lantz's project aims to improve our understanding of the multifactorial etiology of human oral craniofacial clefting. In brief, Brandi's research is focused on determining the physical, molecular and genetic factors that coordinate medial merging of the midface during craniofacial development. Ms. Lantz also is testing how the nasal septum contributes to normal and abnormal nose morphology. She presented a poster at the Gordon Research Conference on Craniofacial Morphogenesis and Tissue Engineering in Luca, Italy, in February, 2018. She has been accepted into Commitment to Access Resources and Education program, where she received the Dean's Excellence Scholarship.

John Li studies the progression of Temporomandibular Joint Disorder (TMJ). He wants to know whether malocclusion can lead to oral pain and how long it takes before the damage becomes irreversible.

Vera Liu assesses the impact of a splint-induced malocclusion on the histology of the condyle in the rat. The results of this study were presented at the 2018 AADR Annual Meeting, Fort Lauderdale, Fla.

Victoria Smorthurst is working on understanding the regulatory role of transcription factor TRPS1 in phosphate-induced differentiation of odontoblasts. She also is working on understanding the interaction between TRPS1 and VDR during the same process. Moreover, she is involved in the study of phosphate-induced matrix vesicle production. Ms. Smorthurst presented her research at the Pitt Dental Medicine Seventeenth Annual Research Symposium in 2017.

Mostafa Shahabedin's research focuses on developing sustained release polymer (PGA) microspheres for treating periodontal disease. When locally delivered in periodontal tissues, these polymer microspheres will release encapsulated antiinflammatory cytokines that modulate immune response and halt tissue destruction. The long-term goal of this project is to translate this strategy into an FDA-approved therapy that will improve patient outcomes. Mr. Shahabedin presented his research at the 2018 AADR/CADR meeting in Fort Lauderdale, Fla.

Xu Yang's research focuses on the understanding of protein trafficking in ameloblasts. He is working to reveal the secretory pathway of keratin 75, a cytosolic protein lacking signal sequence required for classical secretion. He defended his dissertation entitled “Unconventional protein secretion of keratin 75 by ameloblasts in vivo.” Mr. Yang has received travel awards from the International Conference on Chemistry and Biology of Mineralized Tissues held in May, 2017, in Potsdam, Germany, and the Hinman Student Research Symposium held in November, 2017, in Memphis, Tenn.

Yuqiao Zhou investigates rural-urban disparities in oral health risk factors in Appalachia. Currently, Ms. Zhou is working on her PhD dissertation, focusing on the genetics of tooth eruption phenotypes combining studies of animal models and human genetics data. She was selected for an oral presentation at the 2018 AADR/CADR Annual Meeting in Fort Lauderdale, Fla. She presented at the Pitt Health Sciences 2018 Health Disparities Poster Competition in April, 2018.

Yingyi Liu's aim is to understand the association between select clinicopathological factors [sex, age, oral site, history of oral dysplasia, histologic grade, depth of invasion and treatment modality] and local recurrence of early-stage oral squamous cell carcinomas. Oral squamous cell carcinomas maintain a recurrence rate of 15-30% even when the cancer is completely excised. Early stage oral cancer is frequently first encountered by dental clinicians and preferentially treated with surgery over chemotherapy or radiation. The results of these studies will help to improve diagnosis and treatment of oral cancers. Dr. Liu has been awarded the Robert and Kay Schattner Award for Best Oral Presentation at the Meeting of the American Academy of Oral Medicine in San Antonio, Texas, in April, 2018. Dr. Liu is a resident in oral and maxillofacial pathology and an MS student in the oral biology graduate program.
Research Focus
• Regenerative medicine of cranio-maxillofacial defects
• TMJ reconstruction with tissue engineering
• Stem cell-mediated regeneration of lost tissues
• Sleep apnea outcomes
• Virtual surgical planning outcomes
• Reabsorbable metal technologies
• Clay-and craniofacial anomalies

Training
The program is designed to be truly integrated and allow for the maximal benefit of coordinated medical training and the progression of knowledge and skill in oral and maxillofacial surgery. Residents are exposed to the full scope of oral and maxillofacial surgery throughout their training.

including interdisciplinary care. From the outset, new residents work with both professional dental students in a training and supervisory role in the undergraduate OMS clinic. Residents also are required to attend the Department of Oral and Maxillofacial Surgery Grand Rounds, Journal Club, treatment planning conferences in the Dentofacial Deformities Program (in conjunction with the Orthodontic Program), and the weekly Surgical Treatment Planning, Implant, and Trauma Conferences.

Criteria
• All residents must be graduates of a CODA-accredited U.S. or Canadian dental school.
• Applicants must hold a DMD degree or its equivalent and have passed the examination for certification in prosthodontics.
• Each resident is exposed to all periodontal diagnoses and therapies and is expected to provide specialty care to infants, children, adolescents, and individuals with special needs.
• There is a scheduled Maxillofacial Surgery Grand Rounds, Journal Club, treatment planning conferences in the Dentofacial Deformities Program (in conjunction with the Orthodontic Program), and the weekly Surgical Treatment Planning, Implant, and Trauma Conferences.
• Clinical Training
• Advanced diagnostic and clinical training necessary to provide specialty care to infants, children, adolescents, and individuals with special needs.
• Diagnosis, prevention, and treatment/management of abnormal congenital or developmental relationships of the dentofacial anatomy, from infancy to adulthood, in diverse populations.
• Application deadline is September 15 of each year.

Periodontics and Preventive Dentistry
Periodontal Certificate with Optional MDS

Research Focus
• Developing devices to regenerate periodontal structures. A focus on magnesium-based devices
• Stem cell-mediated regeneration of lost tissues
• Molecular pathology of periodontal disease
• Implant healing in medically compromised patients
• Clinical aspects of tissue healing around implant

Clinical Training
• Each resident is exposed to all periodontal diagnoses and therapies and is expected to provide specialty care to infants, children, adolescents, and individuals with special needs.
• Teaching residents the full scope of oral and maxillofacial surgery throughout their training.
• Clinical Training
• Advanced diagnostic and clinical training necessary to provide specialty care to infants, children, adolescents, and individuals with special needs.
• Diagnosis, prevention, and treatment/management of abnormal congenital or developmental relationships of the dentofacial anatomy, from infancy to adulthood, in diverse populations.
• Application deadline is September 15 of each year.

Criteria
• Applicants must hold a DMD degree or its equivalent and have passed the examination for certification in prosthodontics.
• Each resident is exposed to all periodontal diagnoses and therapies and is expected to provide specialty care to infants, children, adolescents, and individuals with special needs.
• There is a scheduled Maxillofacial Surgery Grand Rounds, Journal Club, treatment planning conferences in the Dentofacial Deformities Program (in conjunction with the Orthodontic Program), and the weekly Surgical Treatment Planning, Implant, and Trauma Conferences.
• Clinical Training
• Comprehensive multidisciplinary treatment planning and restoration of teeth, supporting structures, speech, esthetics, function, and comfort following caries, periodontal disease, trauma, severe wear, neoplasms, and TMJ conditions.
• Implant supported restorations
• Digital Dentistry fabricated restorations via CAD-CAM and 3D printing

Senior Residents must challenge the written portion of the examination for certification in periodontics offered by the American Board of Periodontics. In addition, they must complete at least 1 of the 3 cases required by the Board. Other funded opportunities include: ACP annual meeting and Prosthodontic Board Review Course, 5 session Misch Institute Course (Las Vegas, Nev.), ACP Pa. Chapter annual meeting, Tri-annual M. D. Anderson Cancer Center update course (Houston, Tex.).

Research Focus
• Dental materials
• Industry collaborations to assess and improve restorative treatments

Criteria
• Applicants must hold a DMD degree or its equivalent and have passed the examination of the National Board of Dental Examiners.
• Application must be made through the National Matching Service following all of their guidelines and deadlines. https://www.natmatch.com/dentres/applicants/applications/xml
Jaqueline Burgette
Dr. Burgette’s research addresses oral health disparities in children through health services research. Specifically, Dr. Burgette is conducting research on the impact of malnourished social networks on children’s oral health utilization, practices and dental care experience. She also is examining how mother’s social support influences children’s oral health outcomes in Northern Appalachia and the relationship between personal and global social network characteristics and dental use among adolescents.

Robert L. Engelmeier
Dr. Engelmeier’s research interests include occlusion and biomechanics, computer-aided design and manufacturing (CAD/CAM), 3-D printing, and development of denture teeth historical research.

Pouran Famili
Dr. Famili’s research interests include the clinical periodontal manifestations and the implications of the link between oral and systemic health, surgical technique in implant placement, systemic bone loss and implant success, periodontal epidemiology, and periodontal implant maintenance.

James Guggenheimer
Dr. Guggenheimer’s research interests are focused on the analysis of electronic health records of patients at the School of Dental Medicine to characterize their socioeconomic and health attributes. Areas of particular interest include cigarette smoking and smoking-related diseases within the context of smoking interventions. Another study examines patterns associated with the use of hospital emergency departments for the treatment of painful dental emergency conditions and the inappropriate use of opioid pain relievers. Additional studies examine the effects of the monoclonal antibody denosumab in conjunction with vascular endothelial growth factor inhibitors on alveolar bone and medication-related osteonecrosis of the jaw.

Zsusza Horvath
Dr. Horvath conducts research on best practices in dental education and faculty development. Her scholarly activities focus on three areas: 1) institutional surveys of dental schools in North America; 2) program evaluation; and 3) evaluation of educational materials. Her overarching aim is to...
apply effective practice in teaching and research in order to explore areas of improvement at the local or national level, share evidence-based recommendations to enhance dental education, and disseminate best practices in order to contribute to the broader dental education community. Currently, Dr. Harvath serves as the principal investigator on the University of Pittsburgh Center of Excellence in Pain Education: Pain Challenges in Primary Care (CoEPE), a five-year grant funded by the National Institute of Health/National Institute for Drug Abuse (NIDA). As part of the project, Dr. Harvath’s team is creating online interactive educational materials in pain medicine to be implemented in the five health sciences schools at the University of Pittsburgh. These materials will then be disseminated by NIDA nationwide. Her team is currently administering the fifth round of implementation and planning evaluation and publications.

Thottala Jayaraman
Dr. Jayaraman’s long-term interests are in identifying and characterizing the role of phospholipids containing signaling molecules that are important for bone mineralization. He specifically examines: 1) the structural elements in SIBLING proteins that promote bone mineralization in bone and dentine; and 2) whether phospholipids affect mineralization by direct or indirect activation of signaling pathways. While intra- and extracellular lipids are known to play an important role in both physiological and pathological processes, detailed information on lipid composition at a local level, as well as the location of biochemical reactions that modulate calcium-signaling pathways in osteoblasts and odontoblasts, is crucial for understanding their roles in cellular function and dysfunction in bone and dentine.

Satish Kumar
Dr. Kumar’s educational background includes periodontology and dental implantology, oral medicine, temporomandibular disorders and orofacial pain. His research training includes basic science research to understand oral carcinogenesis, clinical research design and management, and evidence-based medicine and dentistry. His primary research interests include clinical research on selected oral, periodontal and peri-implant diseases and dental education. He also is interested in evaluating the reporting quality of published research that is directly relevant to clinical care such as randomized controlled trials and systematic reviews. Dr. Kumar has published several original articles, reviews, case reports, critical summaries, book chapters and online educational materials in periodontology and oral medicine, and conducts peer review of scientific articles for leading journals.

Thomas Craig Kunkel
The area of digital dentistry is rapidly growing in the field of prosthodontics. CAD-CAM technology coupled with CEREC innovation has created numerous research opportunities. The marginal fit of CEREC materials in fixed prosthodontics is a current research interest. Also, the use of CEREC in evaluating students in a pre-clinical setting is being studied. PrepCheck (Sirona, Inc.) is being utilized to objectively evaluate pre-clinical tooth preparations. This will be compared to the evaluations given to students in a more subjective, instructor-oriented environment.

Anchal Malik
Dr. Malik is greatly involved and interested in the teaching of cariology to pre-doctoral DDS students, and her research interests relate primarily to caries management, including risk assessment, early caries detection, development and/or prevention, developmental defects of enamel, particularly enamel hypoplasia, early childhood caries, health disparities, and evidence-based practice. She is currently co-director of the cariology course and co-coordinator for the discipline of cariology in the curriculum. She is also interested in developing and integrating new teaching methods to improve dental education especially in the area of caries disease management that will help develop competent dentists in the area of caries management, and use of evidence-based information in order to improve the oral health of patients and the community.

Mary L. Marazita
Dr. Marazita’s primary research interest is in the genetics of cleft lip, cleft palate, and other craniofacial and dental anomalies, as well as the genetics of normal facial development. She is applying a coordinated approach, exploiting both statistical and molecular tools to investigate the etiology of these common, complex, human traits. In addition, she is investigating familial ascertainment through several international collaborations (e.g., China, Colombia, India, Hungary, Denmark, Argentina, Turkey, India, Canada, the Philippines, and Nigeria), utilizing a rich phenotyping approach to inform etiologic studies.

Another major area of current investigation is genetic, microbial and epidemiological factors that contribute to oral health and oral diseases such as dental caries, in Appalachia and other regions worldwide. Also, she has active research collaborations in the genetics of several behavioral and psychiatric traits, as well as several other human disorders (e.g., premature birth, autonomic nervous system dysfunction and otitis media). Dr. Marazita is involved in the NIDCR FaceBase Consortium (www.FaceBase.org), the NHGRI Consensus Measures for Phenotypes and Exposures Initiative (PhenX, www.PhenX.org), the NIH Director’s Office Gabriella Miller Kids First Pediatric Research Initiative (Kids First, https://commonfund.nih.gov/kidsfirst), the NIH Director’s Office All of Us Precision Medicine Research Program (All Of Us, https://allofus.nih.gov/) and other national and international research initiatives.

Nina Markovic
Dr. Markovic is an Associate Professor in Dental Public Health and Co-Director of the Center for LGBT Health Research at the Graduate School of Public Health. Her research interests include health risks associated with minority status with a special focus on women, women’s health during the reproductive years and psychosocial and social rank factors associated with risk factors for cardiovascular diseases.

Adriana Modesto-Vieira
Dr. Modesto-Vieira’s research interests involve topics in two main areas: (1) pediatric dentistry with emphasis in cariology, and dental trauma; (2) oral microbiology with emphasis in bacterial adhesion models, antimicrobial activity analysis, biofilm models, and bacterial DNA fingerprinting.

Mark P. Mooney
Dr. Mooney’s interests include the etiology and pathogenesis of cranioschial anomalies, the development of animal models to study cranioschial growth and development, and the effects of extreme environments on human growth, development and evolution.

Paul A. Moore
Dr. Moore’s research interest continues in investigating dental therapeutics in dentistry and anesthesiology. He has initiated randomized controlled clinical research trials, practice surveys and comprehensive reviews of the safe and effective use of analgesics, sedatives and local anesthetics as used in dentistry for pain control. He has served as principal investigator on 40 sponsored awards throughout his career.

Dobrawa Napierala
Dr. Napierala’s research is focused on molecular determinants of disturbed development and homeostasis of mineralizing tissues, and in regeneration and repair of these tissues. Dr. Napierala studies diseases associated with defective endochondral ossification, formation of dental tissues, bone mineral density and ectopic mineralization. She is interested in the role of the TRPS1 transcription factor in skeletal and dental development and homeostasis, and in the mineralization process. Related to this, Dr. Napierala studies the phosphate-signaling pathway in mineralizing cells and the biogenesis of matrix vesicles, which play important role in the initiation of the mineralization process of bone, cartilage and dentin, and have been implicated in vascular calcification.

Andrea Nave
Dr. Nave’s research interests include behavior management and personality, and sedation for pediatric dental patients.

Katherine Neiswanger
Dr. Neiswanger’s research interests focus on the genetics of complex diseases affecting oral health,
especially dental caries in children and phenotypic development in nonsyndromic cleft lip with or without cleft palate. She serves as the program manager for the Center for Oral Health Research in Appalachia (COHRA), a collaboration between the University of Pittsburgh’s Center for Craniofacial and Dental Genetics (Dr. Mary Marazita, director), West Virginia University, and the University of Michigan. COHRA is enrolling a large sample of pregnant women and their babies and collecting longitudinal data to study the genetics, microbiology, and environmental factors predisposing children to early childhood caries.

Marnie Oakley
Dr. Oakley’s primary research interest inudes topics related to leadership development and ethics. Dr. Oakley also has research interests in the use of social media in dental education, mentoring of the clinical academician in research-related activity, and prescription drug abuse.

Jean A. O’Donnell
Dr. O’Donnell’s research interest in teaching and learning reflects her role as Associate Dean for Academic Affairs, managing the predoctoral curriculum at the School of Dental Medicine. A former nurse, she also is interested in tobacco cessation research and currently is the SDM site PI on an NIH-funded grant in collaboration with the University of Sydney, Indiana University, and Health Partners Institute to assess the utility of an electronic clinical decision support system for improving dental providers’ delivery of brief tobacco interventions. Additionally, she is interested in interprofessional education and collaborative practice to improve patient outcomes through teamwork. She is a member of the Schools of the Health Sciences Working Group on Interprofessional Education and has collaborated with members of the group to pilot interprofessional experiences for students involving two or more professions working together. Her interest in prescription drug abuse led to a collaborative publication with faculty at the Schools of Dental Medicine and Pharmacy and to co-mentoring a first-year dental student on a project of the same topic.

Deborah E. Polk
Dr. Polk studies how broader social factors create disparities in health behaviors and indicators of health at the individual level. Examples of social determinants she is interested in include social norms and public policies. Examples of health behaviors include smoking and oral hygiene behaviors. The health outcomes she studies include dental caries and periodontal disease. In addition, she identifies social and behavioral contexts in which genetic variants increase the probability of disease.

Anitha Potluri
Dr. Potluri’s research interest includes utilizing electronic health records (EHR) to assess the frequency of fibro-osseous conditions in western Pennsylvania populations. She also is involved in analyzing and quantifying the changes around implants using digital subtraction radiography and CBCT imaging. Additionally, her interests are in three-dimensional imaging with emphasis on cone beam volumetric imaging and analyzing the incidental findings and radiographic patterns of intraoral bone pathology.

Joanne L. Prasad
Dr. Prasad’s research interests vary broadly from the clinical, radiologic, and histologic profiles of oral lesions to topics of relevance to dental public health and dental education. Currently, she is involved in research projects focusing on fluoridation and caries prevalence in Appalachian children, the attitudes of health professionals towards opioids in dentistry, and innovative ways to enhance communication skills in students of dentistry.

Herbert L. Ray
Dr. Ray’s research interests include conservative pulp therapies focusing on the resiliency of the dental pulp and the development of pulp dressings that promote dental pulp survival and dentinogenesis. Dr. Ray’s other interests are in regenerative pulp therapies utilizing both dental pulp stem cells and novel materials to create a biological obliteration of the root canal system.

Richard W. Rubin
Dr. Rubin’s main interests are in exploring the interface of public health and oral health, and in developing culturally competent/community- minded dental students. His research explores the development of these attitudes and beliefs among dental students and the relationship of the effectiveness of our dental school’s Student Community Outreach Program and Education (SCOPE) activities in this process. The SCOPE program also was mentioned in the American Dental Education Association (ADEA) Center for Policy and Research Best Practices in Dental Education 2004, and referenced in the 2006 ADEA Report of the Panel of the Marx Study. He also is interested in evaluating and implementing new approaches to teaching and learning. This includes techniques based on active adult-learning models, “learning communities” and applications of cognition theories. Dr. Rubin has been the liaison between the School of Dental Medicine (SDM) and the Graduate School of Public Health for the joint DMD/MPH program, and, in 2016, he designed and is currently directing the Certificate in Dental Public Health program at the SDM.

Charles Steir
Dr. Charles Steir is the Associate Dean for Research, Director of the Center for Craniofacial Regeneration and Chair of the Department of Periodontics and Preventive Dentistry. Dr. Steir also holds a faculty appointment in the Departments of Oral Biology, Bioengineering, and the McGowan Institute for Regenerative Medicine. He received a DDS degree from the Université Louis Pasteur in Strasbourg, France. He earned a degree in Periodontology and holds a PhD in Molecular Biology from Northwestern University in Chicago, Illinois. Dr. Steir’s research focuses on:

• Bone and Dentin Tissue Engineering, utilizing biomaterials and cellular strategies to regenerate mineralized tissues:
  - Biomimetic scaffold development for bone/dentin tissue engineering using biomineralization principles.
  - Biomaterials development such as calcium phosphates or polymeric materials to regenerate bone and dentin.

• Engineering cellular therapies for bone and dentin regeneration. Strategies involve scaffoldless systems as well as stem cells in combination with biomaterials.

• Identifying the signaling pathways involved in stem cell differentiation to bone cells.

• Biomineralization, Posttranslational modifications of non-collagenous proteins in bone and dentin.

• Roles of protein kinases in bone and dentin formation.

• Role of phosphorylation in biomineralization.

• Modulation of the immune system to develop therapies for periodontal disease.

• Strategies to modulate the immune system to develop therapies for periodontal disease. These strategies involve local peptide or molecular agent delivery to attract macrophages or a subset of macrophages to treat periodontal disease.

• Biodegradable metals, developing load bearing bone fixation devices.

• Ressorbable metals are attractive materials because of their 1) load bearing properties due to their initial mechanical strength; 2) modulus similar to native bone; 3) biocompatibility, and 4) ability to degrade in vivo.

• Pulp tissue regeneration, develop strategies to achieve better endodontic therapies using biomaterials versus cellular approaches.

• Preclinical testing devices for FDA approval. Our laboratory operates in a GMP-like environment. Standard Operating Procedures (SOPs) are developed for every experiment carried out in the laboratory. We have also implemented quality control procedures.

Nillesh Shah
Dr. Shah’s research interests include latent class modeling, longitudinal data analysis, survival analysis, and predictive modeling.
Sayuri Smith
Dr. Smith’s goal is to make a new effective dental treatment method based on basic science, especially for periodontitis. She collaborates with chemical and bioengineers to explore new materials for dental treatments. Currently, she is working on the following projects: biological analysis of bone fixation devices made from biodegradable magnesium alloys, and periodontal treatment via recruiting regulatory T-cells using drug releasing microcarriers. She believes that her unique expertise in dentistry/biology and collaboration with excellent engineers will advance the current dental treatment in the near future.

Deborah Studen-Pavlovich
Dr. Studen-Pavlovich’s research interests include adolescent dentistry, behavior management, and sedation for pediatric dental patients.

Kurt F. Summersgill
Dr. Summersgill’s research interests currently center on outcome assessments of the oral pathology-biopsy laboratory service and the clinical oral medicine practice, which includes datamining of the electronic health record (EHR). He has worked with residents on cancer preventive agents, pathologic features of dermal fillers, digital cytology, and quality assessment of digital oral pathology.

Fatima Syed-Picard
Dr. Syed-Picard’s research focuses on stem cells and tissue engineering for the following applications: 1) implantable devices for craniofacial therapy, 2) models of craniofacial tissue development and regeneration, and 3) models of craniofacial disease. She is working to regenerate tissues including bone, dentin-pulp complex, and nerve for therapeutic use. Furthermore, Dr. Syed-Picard uses engineered tissues as a model to study basic developmental processes including tissue patterning. Her research utilizes predominantly cell-based, scaffold-free tissue engineering where cells are able to generate and organize their own 3D structure and have the capacity to self-assemble into spatially organized multisscale structures. Dr. Syed-Picard uses a number of engineering tools to study these constructs including advanced microscopy and microfluidic devices.

Heather Szabo-Rogers
The Szabo-Rogers laboratory is focused on understanding the embryological development of the face and skull. Using a combination of classical embryology and cell biological techniques, the laboratory is characterizing the signaling pathways and tissue interactions that are needed for normal development of the skull and face. We will use this information to determine how craniofacial anomalies including cleft lip and palate and craniosynostosis arise during embryogenesis. Additionally, our findings can be integrated into regenerative therapies being developed within the Center for Craniofacial Regeneration (CCR).

Juan M. Taboas
Dr. Taboas works to regenerate skeletal interfacial tissues, with a focus on cartilaginous tissues. His laboratory has created several tools to control the cellular microenvironment and guide tissue growth, including photopatterned biomaterial scaffolds, controlled drug delivery, microfluidic biochips, and real-time microscopy-based analysis of cell–material interactions. The laboratory’s biomaterials and drug delivery technologies are funded for treatment of skeletal and craniofacial injuries and diseases.

Antonia Teruel
Dr. Teruel’s current research interests are focused on the field of orofacial pain. She is interested in understanding the clinical characteristics and management of chronic orofacial conditions, such as temporomandibular disorders, chronic trigeminal neuropathy and trigeminal neuralgia. She currently is pursuing pain education research, particularly, how oral health care professionals learn about chronic orofacial pain and its treatment. Also, she is interested in improving the survivorship care of patients who have received treatment for head and neck cancer.

Konstantinos Verdelis
Dr. Verdelis’s research interests include mineral and matrix changes in the dentin and enamel of developing teeth and the function of SIBLING proteins in the dentin, enamel and bone mineralization. For these studies he also has focused on the use of spectroscopy, Fourier Transform Infrared and Raman, imaging coupled with microcomputed tomography and histology. His research also has focused on the use of microcomputed tomography for analysis of bones and teeth morphology and dentistry, as well as anatomo-critically- and clinically-oriented studies in endodontics. He currently serves as the director for the microcomputed tomography core at the School of Dental Medicine and the scientific consultant at the microCT core of the Allegheny General Hospital Cardiovascular Institute.

Alexandre R. Vieira
Dr. Vieira’s research interests include two main lines of investigations: 1) individual susceptibility to craniofacial, oral and dental diseases and conditions, and 2) the impact of oral health issues on oral health. The laboratory currently is developing projects on strategies to analyze genomics and oral microbiome data in combination with comprehensive clinical descriptions; the reasons why individuals born with clefts and/or dental anomalies are more susceptible to cancer later in life, and the impact of genetics on painful responses and resistance to certain drug treatments. His repository of clinical data linked to biological samples, the Dental Registry and DNA Repository, has allowed the development of investigations on a variety of oral health outcomes.

Christine Wankiiri-Hale
Dr. Wankiiri-Hale serves as the Associate Dean for Student Affairs at the University of Pittsburgh School of Dental Medicine. Her current research interests include evidence-based practice in dental education, research related to academic career paths in dental medicine, enhancing diversity in dental schools, and dental school admissions-related research. She is a member of several professional organizations, including ADEA, ADA, PDA and NDA, and she has presented nationally on her interests.

Seth Weinberg
The goal of Dr. Weinberg’s research program is to leverage advanced 3D imaging, morphometrics, and genomics tools to better understand the biological determinants of quantitative craniofacial traits (e.g. cranial size and shape) and congenital anomalies that affect the head and face (e.g. cleft palate).

Robert J. Weyant
Dr. Weyant studies caries with an emphasis on early childhood caries. His other research interests include health disparities, social epidemiology, evidence-based practice and implementation science.

Samer H. Zaky
Dr. Zaky’s research interest focuses on: 1) Osteo-inductive-like substrate for bone engineering: While the selection criteria for bone engineering scaffolds are based chiefly on their relative mechanical comparability to mature bone, the Center for Craniofacial Regeneration (CCR) is challenging this preconception by studying and demonstrating that scaffolds with low stiffness would allow a load-transducing milieu in which osteogenesis, matrix deposition, and eventual bone maturation can take place. Such “soft” environment is considered to be mechanically closer to bone marrow and osteoid tissues as a common origin from which cortical as well as trabecular types of bone mature, each with its distinct mechanical properties. Dr. Zaky is investigating the molecular events and biomechanical cues that lead to progenitor/stem cell differentiation for osteogenesis and bone maturation on a soft substrate. His research would shed light on the molecular mechanisms involved in bone tissue development and would identify the best biomimetic approach to recapitulate its development. 2) Regenerative endodontics: It is of global consensus that the best replacement for dental pulp tissue in the root canal system is a genuinely cellularized, vascularized, and innervated tissue. The regenerated tissue would create a biological obturation of the pulp space providing a host response to future bacterial invasion while permitting surrounding mineralized tissues the ability to maintain its normal physiological state. The CCR approach to dental pulp regeneration is by employing extracellular matrix as a scaffold to support cell homing from the periapical tissue to the pulp space.
Our country faces an epidemic of opioid and substance use disorders. One approach to address this problem is to develop non-opioid analgesics. The most common pain disorders treated by dentists are inflammatory in nature. Tissue injury leads to the local release of many inflammatory mediators, including oxidized linoleic acid metabolites (OLAMs). The OLAMs activate the so-called “capsaicin receptor”, TRPV1, contributing to the development of inflammatory pain. Here, we will review the discovery of the OLAMs, their actions in activating TRPV1, and their role in inflammatory dental pain, as well as pain due to burns and other injuries. Discovery of these endogenous mediators has led to the development of a novel class of non-opioid analgesic drugs that treat pain at the source.
Dr. Anitha Potluri serves as the director of the division of Oral and Maxillofacial Radiology and chair of the Department of Diagnostic Sciences. Her interest in digital dentistry includes 3D imaging, integration of intraoral scanning and 3D printing. Her role is to facilitate integration of all digital modalities into a PACS system and EHR seamlessly with streamlined workflow among areas that are utilizing these modalities. She has extensively researched aspects of other dental schools’ workflow, curriculum and technology to help decide upon with the immediate needs of School of Dental Medicine. Dr. Potluri’s work with digital dentistry at Pitt now revolves around ways to integrate it into one open accessible system, to identify the right equipment for the school and how to keep digital technology up-to-date.

The expertise of biomedical scientist, Dr. Juan Taboas, lies in the fields of skeletal tissue regeneration, tissue engineering scaffolds, microfluidics devices and real-time live-cell microscopy-based functional bioassays. An assistant professor in the Center for Craniofacial Regeneration (CCR) and the Oral Biology department, his laboratory investigates approaches to regeneration of cartilaginous interfacial tissues and also collaborates with fellow CCR investigators to regenerate other skeletal and craniofacial tissues. His laboratory employs tools such as biomaterial scaffolds, microfluidic bio-reactors and real-time microscopy-based analysis to study cell-material interactions in engineered microtissues.

Clinical assistant professor, Dr. Timothy Erdle, earned his periodontics certificate in 2016 from the Pitt Dental Medicine Department of Periodontics and Preventive Dentistry. He received his DMD from the Midwestern School of Dental Medicine after obtaining BS in Molecular, Cellular and Developmental Biology in 2009. His training culminated in becoming a Diplomate of the American Board of Periodontology. Throughout his training, Dr. Erdle has been consistently recognized for his outstanding clinical skills and developed extensive expertise in the 3D printing. Dr. Erdle’s research interests lie in the area of digital dentistry and 3D Printing.

Digital is the future of dentistry for teaching, practice and research. Digital patient care is rapidly becoming a standard of care in most of schools and private offices. Digital dentistry includes electronic health records, imaging, E-teaching, practice, and research with true integration of all fields. Digital teaching includes learning at convenience all aspects of dentistry and virtual simulation of clinical procedures. Digital patient care offers seamless integration of patient management and practice of different areas and techniques like scanning, imaging, 3D printing, and artificial intelligence, from diagnosis to manufacturing utilizing open platform and secured technology. Today’s presentation addresses where we are with this digital curriculum and practice, where we want to go and what is coming next.

Digital Dentistry: Are We Ready?

Luncheon Keynote Speakers

Anitha Potluri  DMD MDcs
Associate Professor and Chair, of the Department of Diagnostic Sciences
Director of the Division of Oral and Maxillofacial Radiology
Director of Admissions of the International Advanced Standing Program

Juan Taboas  MS PhD
Assistant Professor

Timothy Erdle  DMD
Clinical Assistant Professor
**Root canal therapy** is a common dental procedure to treat carious teeth, with over 15 million procedures per year in the USA. The procedure comprises decay removal, root canal shaping, sterilization, and void filling with an inert material. Subsequently, the chamber is sealed and the crown restored. The therapy leaves a dead but otherwise mechanically functional tooth. Unfortunately, approximately 15%-30% will become re-infected or fail. Re-treatment is more costly and prone to failure. Hence, practitioners and patients opt for tooth extraction and dentures or implants. A living tooth would be able to sense temperature, injury, and infection, and thereby protect the tooth from damage and fight infection. Revascularization is a clinical method to regenerate the pulp, the living tissue, within a tooth. However, it is only successful in children because their teeth are still growing. Clinicians and scientists are developing numerous approaches to regenerate pulp, employing combinations of cells, drugs, and biomaterials. To date, no therapeutic method or commercial product exists to revitalize root canal treated teeth in adults.

We are developing a cell-free pulp regeneration device for root canal therapy in adults (Vital-Dent) that can be used without special training or facilities by practitioners in their clinics. Cell-free therapies require recruitment of cells and neurovascular tissue into the tooth to rebuild tissue, such as stem cells from the periodontal ligament that surrounds the tooth. In this work, I developed a porous collagen sponge scaffold to act as a scaffold for pulp regeneration using porogen leaching and thermal denaturation for fabrication. The sponge mechanical and physical properties were measured, and tensile to cells was evaluated. The sponges were then tested in a chorioallantoic membrane (CAM) model for their cell migration and blood vessel growth potential. Two sponge types were tested: 1) sponges soaked with drugs that promote cell migration, and blood vessel and nerve growth; and 2) sponges soaked in saline without drugs. These were inserted into the center of human tooth slices, placed on the CAM of 7 day old chicks, and cultured for 7 days.

The sponges had appropriate mechanical properties for their intended use, with a dry dynamic modulus of 26 GPa and wet dynamic modulus of 10.5 kPa measured in unconfined compression. Over 75% of their pores were 400 µm or greater, with high interconnectivity measured using mercury porosimetry. The CAM model showed that cells migrated through the entire height of the sponges in 7 days, and that chemotactic agents enhanced the migration.

In conclusion, our scaffolds were found to promote cell infiltration and migration, and have sufficient mechanical properties to replace conventional root canal fillers. Vital-Dent development has continued, testing new drugs and materials, including hydrogel and combination hydrogel+sponge scaffolds that further enhance cell migration and angiogenesis. Experiments are underway that will evaluate living pulp-like tissue formation in root canals of treated teeth in animals.
A retrospective analysis of clinicopathological factors associated with recurrence of early stage oral cancer

Oral squamous cell carcinoma (OSCC) is a life-threatening disease that can cause significant morbidity and mortality. OSCC recurrence occurs frequently, with the rates of recurrence varying between 12% and 40% depending on tumor stage. To date, little is known about which specific clinicopathologic factors are associated with increased risk of local recurrence in patients with early-stage OSCC. A better understanding of the risk factors associated with recurrence will aid in improving follow-up protocols for oral cancer patients.

To address this question, we conducted a retrospective analysis of patient record data collected over the 9-year period spanning 2003 to 2012. We retrieved 50 cases of T1N0 stage OSCC, with 17 cases having experienced local recurrence within 5 years from the date of initial treatment (“recurrence group”), and 33 cases having experienced no recurrence (“control group”). Negative surgical margins were confirmed on all cases. Relevant clinicopathologic data included sex, age, oral site, history of dysplasia, and surgical treatment modality (excision +/- neck dissection).

We found that a significant portion of the tumors (17/50; 34%) experienced locoregional recurrence. The vast majority (34/50; 68%) were classified as well-differentiated tumors. The lateral tongue was the most prevalent site (26/50; 52%) of the index lesion, but displayed the lowest rate of recurrence (13/26; 23.8%). The average age of the recurrence group was 64.4 years, while the average age of the control group was 62.4 years. Importantly, a higher risk of recurrence was found to be associated with a previous history of dysplasia (OR 16.1, p < 0.05) and cancer of a non-tongue site (OR 7.9). In addition, recurrence was noted to be similar in both genders as well as in both surgical treatment modalities.

As this research is ongoing, it would be premature to draw definitive conclusions at this time. Our present data suggest that a history of dysplasia may be associated with a higher risk of recurrence while a lower rate of recurrence is observed with cancer of the tongue. Insular as these findings generalize to other patients with OSCC, dental professionals hold a unique position in their proficiency of oral lesions and ability to follow-up with patients with dysplasia at frequent intervals.

Measuring Microscopic Structures of Human Dental Enamel Gives Insight on Caries Experience

Oral squamous cell carcinoma (OSCC) is a life-threatening disease that can cause significant morbidity and mortality. OSCC recurrence occurs frequently, with the rates of recurrence varying between 12% and 40% depending on tumor stage. To date, little is known about which specific clinicopathologic factors are associated with increased risk of local recurrence in patients with early-stage OSCC. A better understanding of the risk factors associated with recurrence will aid in improving follow-up protocols for oral cancer patients.

To address this question, we conducted a retrospective analysis of patient record data collected over the 9-year period spanning 2003 to 2012. We retrieved 50 cases of T1N0 stage OSCC, with 17 cases having experienced local recurrence within 5 years from the date of initial treatment (“recurrence group”), and 33 cases having experienced no recurrence (“control group”). Negative surgical margins were confirmed on all cases. Relevant clinicopathologic data included sex, age, oral site, history of dysplasia, and surgical treatment modality (excision +/- neck dissection).

We found that a significant portion of the tumors (17/50; 34%) experienced locoregional recurrence. The vast majority (34/50; 68%) were classified as well-differentiated tumors. The lateral tongue was the most prevalent site (26/50; 52%) of the index lesion, but displayed the lowest rate of recurrence (13/26; 23.8%). The average age of the recurrence group was 64.4 years, while the average age of the control group was 62.4 years. Importantly, a higher risk of recurrence was found to be associated with a previous history of dysplasia (OR 16.1, p < 0.05) and cancer of a non-tongue site (OR 7.9). In addition, recurrence was noted to be similar in both genders as well as in both surgical treatment modalities.

As this research is ongoing, it would be premature to draw definitive conclusions at this time. Our present data suggest that a history of dysplasia may be associated with a higher risk of recurrence while a lower rate of recurrence is observed with cancer of the tongue. Insular as these findings generalize to other patients with OSCC, dental professionals hold a unique position in their proficiency of oral lesions and ability to follow-up with patients with dysplasia at frequent intervals.

Genetic associations were found between variants of genes including ameloblastin, amelogenin, enamelin, tubulin, tubulin interactive protein 11, beta defensin 1, and matrix metallopeptidase 20 and enamel structure (number of particles, density, gap distance). Significant correlations were found between caries experience and microhardness and enamel structure. In conclusion, our data support that genetic variation may impact enamel formation, and therefore influence susceptibility to dental decay and future caries experience. The approach presented here of evaluating enamel structure that may impact caries experience allows for hypothesizing that that identification of individuals at higher risk for dental caries and implementation of personalized preventative treatments may one day become a reality.

Opioids in Dentistry: Attitudes and Beliefs of Dental Faculty

Oral squamous cell carcinoma (OSCC) is a life-threatening disease that can cause significant morbidity and mortality. OSCC recurrence occurs frequently, with the rates of recurrence varying between 12% and 40% depending on tumor stage. To date, little is known about which specific clinicopathologic factors are associated with increased risk of local recurrence in patients with early-stage OSCC. A better understanding of the risk factors associated with recurrence will aid in improving follow-up protocols for oral cancer patients.

To address this question, we conducted a retrospective analysis of patient record data collected over the 9-year period spanning 2003 to 2012. We retrieved 50 cases of T1N0 stage OSCC, with 17 cases having experienced local recurrence within 5 years from the date of initial treatment (“recurrence group”), and 33 cases having experienced no recurrence (“control group”). Negative surgical margins were confirmed on all cases. Relevant clinicopathologic data included sex, age, oral site, history of dysplasia, and surgical treatment modality (excision +/- neck dissection).

We found that a significant portion of the tumors (17/50; 34%) experienced locoregional recurrence. The vast majority (34/50; 68%) were classified as well-differentiated tumors. The lateral tongue was the most prevalent site (26/50; 52%) of the index lesion, but displayed the lowest rate of recurrence (13/26; 23.8%). The average age of the recurrence group was 64.4 years, while the average age of the control group was 62.4 years. Importantly, a higher risk of recurrence was found to be associated with a previous history of dysplasia (OR 16.1, p < 0.05) and cancer of a non-tongue site (OR 7.9). In addition, recurrence was noted to be similar in both genders as well as in both surgical treatment modalities.

As this research is ongoing, it would be premature to draw definitive conclusions at this time. Our present data suggest that a history of dysplasia may be associated with a higher risk of recurrence while a lower rate of recurrence is observed with cancer of the tongue. Insular as these findings generalize to other patients with OSCC, dental professionals hold a unique position in their proficiency of oral lesions and ability to follow-up with patients with dysplasia at frequent intervals.

Genetic associations were found between variants of genes including ameloblastin, amelogenin, enamelin, tubulin, tubulin interactive protein 11, beta defensin 1, and matrix metallopeptidase 20 and enamel structure (number of particles, density, gap distance). Significant correlations were found between caries experience and microhardness and enamel structure. In conclusion, our data support that genetic variation may impact enamel formation, and therefore influence susceptibility to dental decay and future caries experience. The approach presented here of evaluating enamel structure that may impact caries experience allows for hypothesizing that that identification of individuals at higher risk for dental caries and implementation of personalized preventative treatments may one day become a reality.

Opioids in Dentistry: Attitudes and Beliefs of Dental Faculty

Dentists are the second-highest prescribers of immediate-release opioids in the United States. Yet, little is known of their attitudes and beliefs regarding the use of opioids in dentistry. Awareness of such attitudes and beliefs can assist in the development of programs aimed at reducing opioid abuse and misuse. The aims of this qualitative study are to determine the beliefs and opinions of clinical faculty at one U.S. dental school on the use of opioids in dentistry and to determine the feasibility of creating an opioid-free dental emergency clinic.

Clinical faculty (DDS/DMD degree) were recruited via posted announcements and emails. Four one-hour long focus group sessions were conducted. Audio recordings of each focus group were transcribed verbatim and reviewed to identify recurrent themes. A code book was developed and the data was analyzed and coded using QSR Nvivo10 software.

A total of 27 faculty participated in the study (11 females and 16 males). Participants included general practitioners (n=13), surgical specialists (n=8), and nonsurgical specialists (n=6). We found strong opposition to implementation of an opioid-free emergency clinic across all 4 focus groups. Several participants indicated disbelief that dentistry might play a significant role in the opioid crisis. Barriers and possible solutions related to controlling opioid abuse and misuse were also identified. Most of the solutions described by participants centered on patient and provider education.

Qualitative research is an effective way to determine attitudes that could impact the feasibility of an intervention. Our study revealed general resistance amongst clinical dental faculty to creation of an opioid-free emergency clinic. Alternative approaches should therefore be considered.
The role of the Director of Student Research is to facilitate the engagement of students in research and scholarly activities. The director oversees the Dean’s Summer Scholarship Program and promotes student participation in AADR meetings. The director also helps students in identifying mentors and mechanisms to improve their involvement in research. Finally, the director oversees the student research competition and encourages participation in the American Dental Association Foundation Annual Dental Students’ Conference on Research and the Hinman Student Research Symposium.

Alessandro R. Vieira, DDS, MS, PhD
Director of Student Research

The University of Pittsburgh School of Dental Medicine Chapter of the American Association for Dental Research (AADR) National Student Research Group (NSRG) provides opportunities for dental students to pursue both basic science and clinical research. The group helps students find projects and mentors that are related to their chosen research topics ranging from regenerative medicine to dental materials. Students also are given the opportunity to present their findings at national meetings, where they will have many opportunities to meet students and professors from other institutions with similar interests.

For more information on potential projects, please visit our website at dental.pitt.edu/research.

Accolades

The American Association for Dental Research 2018 Student Research Fellowship

ByongSoo (Timothy) Chae, third-year dental student
Mr. Chae is the recipient of the AADR 2018 Student Research Fellowship. In support of his research project on understanding the role of tissue-nonspecific alkaline phosphatase in phosphate signaling in dental tissues, this research is important for deciphering the molecular pathology in mineralization disorders caused by phosphate deficiency.

American Association for Dental Research 2018 Student Research Fellowship

Vera Liu
This award recognizes outstanding clinical or basic science research by a first, second, or third-year dental student. The recipient receives a bronze plaque and a trip to the AADR meeting to compete nationally.

Hinman Student Research Symposium Competition

Maer Ahmed
Competitive national research symposium at the University of Tennessee in Memphis for students involved in clinical and basic science dental research

AADR – Local Pittsburgh Chapter Awards

Vera Liu
This award recognizes outstanding clinical or basic science research by a first-, second-, or third-year dental student. The recipient’s name will be engraved on a bronze plaque in the Pitt Dental Medicine Learning Resource Center.

School of Dental Medicine Awards

(Dr. O. Jack Penhall Award)

First place Ariana Kelly
Second place Erin Schwoegl
Third place Cara Maloney

This award recognizes outstanding clinical or basic science research by a dental student and was initiated by Dr. O. Jack Penhall (DDS ’73), a Pitt Dental Medicine alumna who is in private practice in Greensburg, Pa., and is a National ADA Student Research Judge.

American Association for Dental Research 2018 Student Research Fellowship

Thomas W. Braun
Master of Excellence Award
Award recipient will be named at the event

Langkamp-Allison Award

Hira Akbar and Andrea Montoya

The Langkamp-Allison Award recognizes a third-year dental student interested in pursuing a career in dental education.

SCADA Award and Dentsply Sirona Student Clinician Program Award

Patrick Donnelly

This award recognizes outstanding clinical or basic science research by a first, second, or third-year dental student. The recipient receives a bronze plaque and a trip to the AADR meeting to compete nationally.

Hinman Student Research Symposium Competition

Meer Ahmed

Competitive national research symposium at the University of Tennessee in Memphis for students involved in clinical and basic science dental research.

AADR – Local Pittsburgh Chapter Awards

Vera Liu
This award recognizes outstanding clinical or basic science research by a first-, second-, or third-year dental student. The recipient’s name will be engraved on a bronze plaque in the Pitt Dental Medicine Learning Resource Center.

School of Dental Medicine Awards

(Dr. O. Jack Penhall Award)

First place Ariana Kelly
Second place Erin Schwoegl
Third place Cara Maloney

This award recognizes outstanding clinical or basic science research by a dental student and was initiated by Dr. O. Jack Penhall (DDS ’73), a Pitt Dental Medicine alumna who is in private practice in Greensburg, Pa., and is a National ADA Student Research Judge.

ASDA Award

First place Kaitlyn Frey
Second place Timothy Chae
Third place Patrick Donnelly

This award recognizes outstanding clinical or basic science research by a dental student.

Dr. Gerald Orner Award

Tamara Latif

This award recognizes an outstanding fourth-year student researcher who is likely to succeed in postgraduate academic dentistry, and honors Dr. Gerald Orner (DDS ’63). It is provided by a Pitt Dental Medicine Alumni.

Quintessence Award

for Research Achievement

Sara Barnes

This award recognizes an outstanding fourth-year student researcher for their research achievements. The award is provided by the Quintessence Publishing Co., Inc.

AADR Student Research Day Award

Award recipient will be named at the event last year’s award: Jennifer Zhou

This award provides support to participate in the 2018 AADR meeting in Vancouver, British Columbia, Canada (meeting registration cost and help with travel expenses).

ASDA Award

First place Kaitlyn Frey
Second place Timothy Chae
Third place Patrick Donnelly

This award recognizes outstanding clinical or basic science research by a dental student.

Dr. Gerald Orner Award

Tamara Latif

This award recognizes an outstanding第四-year student researcher who is likely to succeed in postgraduate academic dentistry, and honors Dr. Gerald Orner (DDS ’63). It is provided by a Pitt Dental Medicine Alumni.

Quintessence Award

for Research Achievement

Sara Barnes

This award recognizes an outstanding fourth-year student researcher for their research achievements. The award is provided by the Quintessence Publishing Co., Inc.

AADR Student Research Day Award

Award recipient will be named at the event last year’s award: Jennifer Zhou

This award provides support to participate in the 2018 AADR meeting in Vancouver, British Columbia, Canada (meeting registration cost and help with travel expenses).
The Pitt Dental Medicine Dean’s Summer Research Scholar Program provides a unique opportunity for incoming dental students to participate in research prior to starting their first-year curriculum. Thirteen students in the class of 2021 participated in the program in 2017, a record number of participants since the program was established. Student projects spanned the research spectrum for the program, which is supported by Dean Braun and research mentors at the dental school. This program allows incoming dental students with diverse research interests to explore opportunities within the dental school. Participating students are encouraged to continue research throughout their four-year dental program, while building research relationships and developing research skills.

Developing Dental Scholars

For Patrick Donnelly, PhD, under the mentorship of Dr. Juan Taboas, being a summer scholar meant building on his PhD in chemistry and applying his extensive research skills to the field of dentistry. Patrick described, “I spent the summer developing and testing gelatin sponges that were to be used as part of a device for dental pulp regeneration following root canal therapy. The sponges were used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell infiltration as used in a chorioallantoic membrane model at the end of the summer to simulate cell}
Prenatal Androgen Exposure and Tooth Development: Is There a Connection?


Objectives Prenatal androgens have been reported to influence the development of craniofacial structures. While numerous genetic and environmental factors are known to affect dental development, the influence of such hormones is unknown. In this project we test whether 2nd:4th digit ratio (a proxy for prenatal androgen exposure level) is related to the timing of first tooth appearance.

Methods A sample of 57 boys and girls had their hands scanned and digits measured at 2, 3, and 4 years of age. Digit ratios were then calculated and regression was used to investigate the relationship with dental traits.

Results In progress at the time of abstract submission

A Chorioallantoic Culture Model to Evaluate Pulp Regeneration Therapies


Objectives Root canal therapy (RCT) replaces dental pulp tissue with an inert filler, rendering the tooth mechanically functional but non-vital. Acellular regenerative therapies require recruitment of cells and neurovascular tissue into the tooth canals. We have developed a chorioallantoic membrane (CAM) model to evaluate regenerative therapies and develop a potential acellular scaffold that recruits vasculature and periodontal ligament stem cells (PDLSCs).

Methods Gelatin sponges were fabricated into scaffolds and mechanical properties were evaluated in unconfined compression. To simulate RCT, sponges were inserted into silicone rings and sealed with mineral trioxide aggregate on the top side. These were placed on seven-day-old chick CAMs (vasculature source). A full factorial design was used to evaluate the effects of a chemotactic agent (±C) and PDLSCs (±P) on cell and vascular infiltration. A human PDLSC pellet was placed between the constructs and CAM for ±P groups. Sponges were doped with medium with or without C. After seven days, constructs were harvested and stained with hematoxylin and eosin.

Results Gelatin sponges contained interconnected pores (~375 μm width). The sponges had a dynamic compressive modulus of 29±3 kPa. The scaffolds were found to be cytocompatible and supported cell adhesion and angiogenesis near the CAM.

Conclusion These scaffolds can promote cellular infiltration, and have sufficient mechanical properties to replace conventional fillers. Subsequent work will investigate vital pulp-like tissue formation in vivo. Due to infiltration of CAM fibroblasts, species-specific staining and longer time-points will be used to evaluate chemotactic effects on PDLSC migration.

Formation of Organized Periodontal Tissues Using Scaffold-Free Tissue Engineering

K. Grey, K. Rothemund, F.N. Syed-Picard

Objectives A major challenge in regenerative periodontal tissues is simulating its complex structure containing both mineralized tissues and ligament. The goal of this study was to determine if a multi-tissue construct resembling periodontium could be formed from human periodontal ligament stem/progenitor cells (PDLSCs) using scaffold-free tissue engineering. Scaffold-free tissue engineering allows cells to generate and organize a 3D structure without exogenous scaffold material. Previously, scaffold-free tissue engineering has facilitated the formation of spatially organized multi-tissue constructs. Here we hypothesized that scaffold-free tissues engineered from PDLSCs would result in a multi-tissue construct containing multiple organized tissues of the periodontium.

Methods Scaffold-free 3D tissues were engineered from human PDLSCs isolated from human third molars. PDLSCs were cultivated in osteogenic differentiation media. After the cells became confluent, they contracted their tissue monolayer around two constraint points and formed a scaffold-free cylindrical tissue construct. The resulting constructs were sectioned and histologically characterized using hematoxylin and eosin (H&E) staining, alizarin red staining to detect mineralization, and immunostaining against bone sialoprotein (BSP) as a marker of osteogenic cell differentiation and scleraxis as a marker of ligament formation.

Results H&E staining showed that the constructs formed from PDLSCs were solid and cellular. Positive alizarin red staining and the expression of BSP was localized to the center of the construct indicating the formation of mineralized tissue. Strong scleraxis expression was detected on the periphery of the construct demonstrating formation of ligament.

Conclusion Scaffold-free tissue engineering using PDLSCs resulted in spatially organized multi-tissue constructs with a mineralized bone/cementum core and a periodontal ligament periphery. These results are significant because the generated constructs can be used as a regenerative therapy to treat periodontal disease or serve as a functional model to study mechanisms of tissue patterning in an engineered tissue.

Evidence-Based Practice: Awareness and Application of Radiographic Selection Criteria

A.J. Herr, E.A. Bladaue, A. Patelif

Objectives The Food and Drug Administration (FDA) has published guidelines for patient selection for prescribing dental radiographs. The objective of this study was to assess whether the dental faculty and students were aware of the FDA guidelines, their adherence to these guidelines, and their understanding of the principles of evidence-based dentistry (EBD). We hypothesized the faculty, as well as the students, would be aware of the guidelines and be aware of the term EBD.

Methods A survey on the prescribing practices of dental radiographs was developed from the FDA guidelines at the University of Pittsburgh School of Dental Medicine. The survey was sent to dental faculty and students. The participants were grouped into the categories of dental educators (DE), private practitioners (PP), dental educators/private practitioners (DE/PP), dental residents (DR), and 3rd and 4th-year dental students (IDS).

Conclusion The survey was sent to dental faculty and students. The participants were grouped into the categories of dental educators (DE), private practitioners (PP), dental educators/private practitioners (DE/PP), dental residents (DR), and 3rd and 4th-year dental students (IDS).
Results 67 participants completed the survey. Table 1, row 1 shows the average of the percentages of the participants who stated they were aware of the FDA guidelines and correctly identified the appropriate guideline in 10 different scenarios. Row 2 shows the percentage of participants who stated they knew what the term evidence-based dentistry meant, and row 3 shows the percentage of participants who correctly picked the core principles of evidence-based dentistry. (see Table 1, above).

Conclusion Our data reveals that most participants were not aware of the FDA published guidelines on radiographic selection criteria (range 36-51%). Furthermore, while 100% of those surveyed stated they knew what the term EBD meant, only 43% of all respondents correctly identified the core principles (range: 17% in private practitioners to 67% in dental educators). Full-time dental educators performed the best on this with 67% correctly identifying the core principles of EBD.

Table 1: Participant Awareness of FDA Guidelines

<table>
<thead>
<tr>
<th>DE</th>
<th>PP</th>
<th>DE/PP</th>
<th>DR</th>
<th>3rd Year DS</th>
<th>4th Year DS</th>
</tr>
</thead>
<tbody>
<tr>
<td>36%</td>
<td>42%</td>
<td>35%</td>
<td>40%</td>
<td>51%</td>
<td>44%</td>
</tr>
</tbody>
</table>

Familiarity and Perception of Molar Incisor Hypomineralization (MIH)

J. Huyser, A. Modesto-Vieira

Objectives The purpose of this study was to assess the familiarization and perceptions of oral healthcare providers at the University of Pittsburgh School of Dental Medicine (UPSDM) regarding the knowledge, prevalence, diagnosis, treatment confidence, and etiology factors of Molar Incisor Hypomineralization (MIH).

Methods Surveys were distributed to 514 licensed oral healthcare providers at the UPSDM. 243 surveys were distributed to licensed oral healthcare providers including dental school faculty, hygiene faculty, and dental residents. 271 surveys were distributed to 2nd, 3rd, and 4th year dental students, and 2nd year hygiene students. All the participants were asked to fill out a 12 question survey via online or paper distribution. The MIH survey investigated general perception and knowledge, clinical experience, diagnosis, treatment confidence, views on etiology, and asked for any general comments.

Results A total of 51 (20.99%) licensed oral healthcare providers and 60 (22.14%) student oral healthcare providers completed the survey. The majority of providers who responded had 5 years or less of dental experience (63.96%), while the second largest group of respondents had 21 or more years (22.52%). A majority (53.09%) did not encounter MIH in practice and most (80.77%) observed 0-5% of their patients as having MIH. Despite the low number of patients seen with MIH, a majority (71.87%) of providers knew some or all of the clinical features of MIH. Most respondents were aware that MIH differed from other enamel defects (92.16%). Most providers were unconfident or very unconfident with diagnosing MIH (68.22%) and even more were unconfident or very unconfident treating MIH (76.04%). The three etiological factors chosen most by the providers were genetic factors (34.39%), environmental contaminants (21.34%), and medical conditions (20.53%).

Conclusions Oral healthcare providers at the University of Pittsburgh School of Dental Medicine have a basic knowledge of MIH; however, most of these providers are not confident in the diagnosis or treatment of the disorder. Many reasons for the apparent lack of confidence may be the low occurrence seen in the patient population as well as the majority of providers in this survey having 5 years or less of dental experience.

Measuring Microscopic Structures of Enamel Gives Insight on Caries Experience

A. Kally, A.R. Viera

Objectives The hierarchical structure of enamel gives insight on the properties of enamel and can influence the strength of enamel and ultimately caries experience. Passively, caries experience is measured using the decayed, missing, filled teeth/ decayed, missing, filled surface (DMFT/DMFS) score. The hypothesis of this study was to test the hypothesis that the number of prisms and interprisms (particles) in enamel, density, and average gap distance between the particles influence caries experience.

Methods Scanning electron microscopy (SEM) images of enamel from primary molars were obtained and used to measure the number of particles, density and gap distances between particles and the measurements were tested to verify a genetic association with variants of selected genes and correlations with caries experience and enamel microhardness.

Results Genetic associations were found between variants of genes including ameloblastin, amelogenin, enamelin, tuftsin, tuftsin interactive protein 11, beta defensin 1, and matrix metallopeptidase 20 and enamel structure. Significant correlations (rs values ≥ 0.45) were found between caries experience and microhardness and enamel structure. Further individual analysis showed that 94.25% of individuals with the minor allele and statistically significant associations to our phenotypes match our hypothesis regarding number of particles, density, and gap distance and caries experience.

Conclusion Our data support that genetic variation may impact enamel formation, and therefore influence susceptibility to dental decay and future caries experience. The approach presented here of evaluating enamel structure that may impact caries experience allows for hypothesizing that the identification of individuals at higher risk for dental caries and implementation of personalized preventative treatments may one day become a reality.

Assessment of Unique Gamification Strategies Across Multiple Higher Education Disciplines

D.A. Koval, D. Babichenko, I.B. Grieve, E.A. Bilodeau

Objectives The purpose of this study is to determine whether introduction of gamification strategies into course curricula positively impacts students perception of that course, and whether it enhances their performance, as measured by improvement in final grades. Gamification is the utilization of game-like strategies and elements in a non-game setting. Its increasing incorporation into educational disciplines is theorized to improve student engagement and motivation, potentially resulting in better student learning outcomes.

Methods After obtaining IRB approval (PRO1700180), we examined class performance and anonymous end-of-semester surveys prior to and following implementation of distinct gamification strategies across courses from the University of Pittsburgh School of Computing and Information, School of Pharmacy, and School of Dental Medicine. Sentiment analysis was first done by the authors for each student comment on a five point scale, where “0” was a strictly neutral comment, “1” or “1” corresponded to a negative and positive comment respectively, and “2” or “2” corresponded to the worst or best possible comments given, where students were most passionate in their reflections of the preceding semester. Means and standard deviations were used to determine where inter-rater deviations were used to determine where inter-rater reliability differed by more than a single unit on this five-point scale, and these comments that were flagged to be re-evaluated by reviewers a second time in cohort. Automated sentiment analysis, a set of machine learning techniques for extracting overall emotional direction of a natural language phrase or
Assessment of a Student Peer Tutoring Program in Dental Education

C. Maloney, C.R. Vlaskin-Hale, N. Seger, Z. Horvath

Objectives The University of Pittsburgh School of Dental Medicine incorporates a voluntary student peer tutoring program as one resource available to its predoctoral students. It specifically utilizes near-peer tutoring in both didactic and clinical courses in order to provide additional help to students who may be struggling. The goal of this research project is to conduct an initial program assessment, in terms of the benefits to both the tutors and the tutees.

Methods Data were collected using surveys from the tutors and the tutees, as well as reflective journals written by the tutors. Tutors were surveyed before their semester of tutoring and after its completion. Tutees were surveyed only after completion of the course. Responses to the surveys were analyzed using quantitative analysis, and content analysis was completed for open ended short responses. Reflective journals were analyzed using content analysis.

Results The data provided information on successful elements of the program and logistical problems to be addressed. It gave insight into what tutors hope to gain from the experience and what they were concerned about. Tutees commented on the effectiveness of their tutor and the extent to which tutoring helped their performance in the class.

Conclusion The assessment of the student peer tutoring program showed overall success, providing benefits not only to the tutees, but also to the tutors. In addition to academic credit, the tutors benefit from reviewing the course materials and practicing skills that will help them in their future careers. Based on the initial program assessment, the understanding of the tutors has improved and the tutors gain a valuable experience.

Reflective Journaling in Predoctoral Periodontology Education

E. Schwoegl, M. Rodgers, S. Kumar

Objectives The objective of this study was to improve future learning experiences in clinical education. The study examined dental students’ ability to compose reflective journals during the periodontics clinic rotations.

Methods Each of 76 second-year dental students at the University of Pittsburgh School of Dental Medicine completed two reflective journaling exercises during their initial periodontics clinic rotations. They were provided a writing template with guiding, thought-provoking questions. A total of 144 journals were analyzed independently by two calibrated evaluators. Journals were analyzed using a rubric developed by Kamber, which condensed Morrow’s seven levels of reflection into four categories: Habitual Action (HA), Understanding (U), Reflection (R), and Critical Reflection (CR). Individual, complete thoughts were identified in the students’ journals, and each complete thought was then coded into one of Kamber’s reflection categories. Additionally, each journal’s word count was calculated to explore any possible correlation between journal length and reflections (R and CR).

Results On average, 9.6 complete thoughts were identified in each journal, of which 16.1% contained non-reflections (0.2% HA, 15.9% U) and 83.9% contained reflections (73.8% R, 10.1% CR). The proportion of journals containing CR dropped slightly between the first and second entries (85.2% vs. 82.7%), whereas the proportion containing CR increased from the first to the second entries (11.3% vs. 9.3%). The average word count was 527 words (204-1107) with no correlation between the word count and reflections.

Conclusion A high degree of reflection was observed in the second-year students’ journals in periodontics clinic in a relatively short journal. Future research can look into whether the quality of students’ journals changes as they progress through dental school and if there is any correlation between reflective journaling and improved clinical performance.

Cannabis: Impacts on Patients' Understanding and Treatment

R. Stepphen, S.E. Grafton, K. Ryan Edgers

Objectives The goals of this study were to gather demographics and health statuses of a small patient sample of cannabis users at the University of Pittsburgh School of Dental Medicine and to use this information to understand the prevalence of cannabis use for dental anxiety/pain, the frequency of different methods of use in clinic patients, and how these patients should be treated.

Methods A survey was completed voluntarily by 79 patients (49 males and 30 females, aged 17-77) who reported cannabis use on a standard medical history form to gather information about their using habits. Demographic and health data were collected via anUM Fisher tests were performed to analyze correlations between sex, method of use, and dental anxiety/pain.

Results No statistical significance was found between sex and dental anxiety/pain (P = 0.168) and method of use and dental anxiety (P = 0.170). However, there was a larger percentage of men who reported using cannabis for dental anxiety/pain than women. Additionally, it appeared to be more common for pants and blunts to be used for dental anxiety/pain than other methods of use.

Conclusions Data from this study can be utilized by dentists to become more aware of cannabis use in their patients, as well as different methods of use and reasons for use. It is important to note the differences in cognitive effects between methods of use and how more potent forms of cannabis could impair the ability for a patient to give informed consent. The implementation of non-verbal consent for these patients could be utilized to assess cognitive function prior to obtaining consent. Additionally, with the rise of medical marijuana sites in Pennsylvania, it is likely that cannabis use will be more widely reported. For these reasons, dentists must be knowledgeable on the subject and prepared to properly treat patients who report cannabis use.
An Expression Toolbox for the Retina, Muscles and Sclera of Fetal Mouse Eyes

Y. Wan, C. White, M.B. Rogers, H.L. Szabo-Rogers

Abstract Abnormal eye development is often associated with craniofacial anomalies. As an organ, the eye can be useful in identifying and understanding underlying craniofacial anomalies. Optic development involves sequential interactions between several different tissue types including the overlying ectoderm, adjacent mesoderm and neural crest mesenchyme and the neuroectoderm. In an ongoing expression screen in the lab, we identified several genes that are expressed in unique cell types in the optic region. Here, we describe the complimentary, coordinated patterns of expression of Casq2, PENK, Traf2, Zic1 and Zic3 during mouse eye development. Casq2 is a binding protein and PENK is a neurotransmitter. Neither Casq2 nor PENK have a reported role in cranial development. Traf2, Zic1 and Zic3 are transcription factors that are required for brain and craniofacial development. We found that these five genes are expressed in the major tissue types in the eye including the muscles, nerves, cornea and sclera. PENK expression is found in the sclera and perichondrium. The extra ocular muscles at E12.5 and E15.5 express Casq2. At these time points, the entire neural retina expresses Zic1. Between E12.5 and E15.5, Zic3 is expressed in the optic disk and ciliary body. In contrast, the expression of Traf2, Zic1 expanded from corneal epithelium to the outer layer of the neural retina between E12.5 and E15.5. The expression patterns of these five genes warrant further study to determine their functional role in eye morphogenesis.

Scaffold-free Dental Pulp Cell Sheets to Enhance Peripheral Nerve Regeneration

M. Ahmad, K. Rahiemund, M. Dalley, T. Calabresi, F.N. Syed-Picard

Objectives Peripheral nerve damage is a commonly encountered clinical problem caused by trauma, disease, or surgical injury. The current gold standard treatment utilizes autologous nerve grafts; however, this requires a prolonged repair time and full functional recovery is not achieved. Neurotrophic factors (NTF) are proteins known to enhance axon regeneration and growth. Dental pulp tissue contains a population of stem/progenitor cells (DPC) that secrete NTFs, a characteristic likely due to their neural crest origin. Further, these cells are easily accessible from autologous sources. The goal of this study was to develop and characterize scaffold-free DPC sheets as a NTF delivery system. We hypothesize that DPC sheets will express NTFs including brain-derived neurotrophic factor (BDNF), glial cell line-derived neurotrophic factor (GDNF) and neurotrophin-3 (NT-3), and will accelerate repair of damaged nerves and improve functional recovery.

Methods In this study, we fabricated scaffold-free cell sheets by culturing DPCs to super confluence with and without fibroblast growth factor 2 (FGF2). NTF gene expression of DPC sheets was assessed using qRT-PCR. DPC sheets sequestered was used to culture SHSY5Y neurons to test its effect on neurite extension in vitro.

Results DPC sheets were formed that are robust and can be easily handled. DPC sheets expressed high level of BDNF, GDNF, NT3 genes and this effect was enhanced by the addition of FGF2. DPC sheet sequestered enhanced neurite extension in SHSY5Y neurons indicating that DPC sheets have a positive functional effect on neurons.

Conclusion DPC sheets can be formed which secrete neurotrophic factors and enhance neurite extension in neurons. Scaffold-free DPC sheets show great promise as a new therapy to accelerate the regeneration of damaged peripheral nerves and improve functional recovery.

Correlation Between Arthritic Changes in the Cervical Vertebrae and TMJ

K. Babolola, A. Pofuri, K. Rengasamy, A. Tadinada

Objectives The objective of this study was to retrospectively evaluate CBCT scans to study the relationship between the presence/absence of degenerative changes in the cervical vertebrae and the relationship between TMJ arthritic changes.

Methods Retrospective evaluation of 150 randomly selected CBCT scans of patients referred to The UCONN School of Dental Medicine’s advanced imaging facility was done.

The scans were evaluated using the invivo-5 software reconstruction program. Inclusion criteria were scans that had the TMJ bilaterally and at least the cervical vertebrae C1-C3 in the field of view. The scans were scored for the presence or absence osteoarthritis in both TMJs and their severity using the Wosniok/Troha grading classification.

Grade 1: normal facet joint space (>2mm width); Grade 2: narrowing of the facet joint space (<2mm); Grade 3: narrowing of the facet joint space (<2mm and/or small osteophytes, and/or mild hypertrophy of the articular process; Grade 4: narrowing of the facet joint space and/or moderate osteophytes, and/or moderate hypertrophy of the articular process, and/or mild subarticular bone erosions; and Grade 5: narrowing of the facet joint space and/or large osteophytes, and/or severe hypertrophy of the articular process, and/or severe subarticular bone erosions, and/or subchondral cysts.

Results Of the 150 scans analyzed, 112 (74.6%) had C-spine arthritis while 38 (25.3%) did not have C-spine arthritis while 54 scans (36%) did not have. 80 scans (53.3%) had both C-spine and TMJ arthritis, 32 scans (21.3%) had isolated spine arthritis, 16 (10.6%) had isolated TMJ arthritis while 38 scans (25.3%) had neither C-spine nor TMJ arthritis.

Conclusion: In this small sample size, a significant number of patients show both TMJ and cervical spine arthritis showing a correlation that must be explored further.

Sex Difference in the Numbers of Lateral Canals in Molars

S. Bama, A.R. Vieira

Objectives It is stated in the literature that the existence of bacteria within the root canal system is a leading cause of failure following endodontic treatment. There are a minimal number of studies that have evaluated the existence of lateral canals and the impact these untreated canals could have on the prognosis of treatment. Furthermore, there are limited studies that evaluate if there is a difference in the number of lateral canals between sexes. The purpose of this study was to evaluate the difference in the existence of lateral canals in molars between sexes in extracted teeth.

Methods Over a two-week period, extracted teeth were collected and separated by sex in 1:10 saline solution. 18 teeth (8 molars and 8 premolars) were collected from females. 22 teeth (9 molars and 5 incisors) were collected from males. 24 teeth were not included because of restorations, broken roots, or were not molars. The teeth were accessed and saline dye was placed into each canal system. The individual roots were then sectioned and the lateral canals identified.

Results Teeth included in this study were as follows: 6A Female, 1 mandibular molar, 3 third molars, and 4 maxillary molars. The number of lateral canals identified was 1, 0, and 0, respectively. 6A Male: 1 mandibular molar, 3 third molars, and 5 maxillary molars. The number of lateral canals identified was 0, 3, and 7, respectively.

Conclusions According to these results, there is a difference in the number of lateral canals in molars between sexes. This difference may explain, at least in part, distinct failure rates by sex of endodontic treatment in molars that have been reported.

Periodontal Disease and Periapical Pathology share similar Genetic Etiological Factors

M. Bezamat, H. Cuyang, A.R. Vieira

Objectives The purpose of this study was to identify associations between periodontal disease, periapical lesions and genes present in the
Mammalian target of rapamycin (mTOR) signaling, which is a central regulator for protein synthesis, and Endoplasmic Reticulum stress (ER stress), which is an essential pathway to maintain intracellular homeostasis.

Methods DNA samples extracted from saliva of 654 individuals were genotyped according to presence of periodontal disease and periapical lesions. Samples were obtained from the Dental Registry and DNA Repository project at the University of Pittsburgh. Twenty-seven polymorphisms in eight genes were selected for genotyping.

All samples were genotyped by the use of Taqman chemistry, allele frequencies were calculated and Hardy–Weinberg equilibrium confirmed. Analyses were performed comparing genotypes between affected and unaffected individuals for each phenotype, using the software PLINK with an alpha of 0.002.

Results We found association between the presence of periodontal lesions and RHEB rs3753151 (p=0.0002), and also two SNPs in XBP1 (p=2.097E-06, p=0.04) and EN1 (p=0.05) and ERN1 (1969929, p=0.05 OR=1.56; 95% CI: 0.992-2.44; and 1969650, p=0.02; OR=1.65; 95% CI: 1.072-2.53) showed a trend for association. For periodontal disease, we found association with two SNPs in ERN1 (19696929 for both allele and genotype, p=0.008, OR=1.87; 95% CI: 1.16-3.01) and p=0.03, respectively; rs1969650, p=0.04, OR=1.51; 95% CI: 1.00-2.28), and for allele distribution and TSC1 rs1050700, (p=0.04, OR=1.59; 95% CI: 1.00-2.53).

Conclusions Our studies show that both mTOR pathway and ER stress phenomenon are associated with conditions affecting bone and teeth. The results support that different levels of bone resorption/formation are associated with those genes, suggesting that periodontal disease and periapical lesions share similar underlying genetic etiological factors, which allows us to hypothesize that instead of individually, they should be studied in conjunction in human populations.

Molecular Profiling of Rare Odontogenic Tumors

E.A. Bilodeau, S. Chiosea, A. Berg, S. Muller, B. Purino, R. Seethala

Background Ameloblastomas are now known to demonstrate frequent BRAF V600E or other MAPK (mitogen-activated protein kinase) pathway mutations (usually activating) as well as SMO mutations (usually activating). However, the mutational profile for odontogenic ameloblastomas, ameloblastic carcinomas as well as other rare odontogenic neoplasms is less characterized.

Design19 odontogenic tumors (11 ameloblastic carcinomas (AC) from 9 patients including 1 metastasis, 4 odontomas) were cultured and genetic analyses performed using the software PLINK with an alpha of 0.002. Tested by next generation sequencing (DNA for point mutations in 30 tumor-related genes [p1350; hot spot]), copy number alterations in 24 genes, PMD: 256671). Anatomical site was indexed and clinical follow-up was obtained. CDKN2A and RB1 abnormalities were corroborated with fluorescent in situ hybridization (FISH) and immunohistochemistry (IHC). TP53, CTNNB1, and ATRX abnormalities were corroborated with IHC.

Results Only a small percentage of AA and AC had BRAF (p=0.002; OR=1.59; 95% C.I. 1.00-2.44; and p=0.03, respectively); both allele and genotype, p=0.008, OR=1.87; 95% C.I. 1.072-2.53) showed a trend for association. For periodontal disease, we found association with two SNPs in ERN1 (19696929 for both allele and genotype, p=0.008, OR=1.87; 95% C.I: 1.16-3.01) and p=0.03, respectively; rs1969650, p=0.04, OR=1.51; 95% C.I: 1.00-2.28), and for allele distribution and TSC1 rs1050700, (p=0.04, OR=1.59; 95% C.I: 1.00-2.53).

Conclusions Our studies show that both mTOR pathway and ER stress phenomenon are associated with conditions affecting bone and teeth. The results support that different levels of bone resorption/formation are associated with those genes, suggesting that periodontal disease and periapical lesions share similar underlying genetic etiological factors, which allows us to hypothesize that instead of individually, they should be studied in conjunction in human populations.
was not clearly visible on a standard panoramic radiograph. The lesion was more extensive on the right side and extended to the right buccal vestibule and posteriorly to the molar area. The lesion was 4.6 x 2.7 x 2.3 centimeters. A soft tissue window with contrast showed the lesion had areas of density compared with the nearby soft tissues within the sequestra and also scattered calcifications. It also showed the extent of the expansion, thinning of the cortices, and preservation of the cortices.

Results Central giant cell granulomas (CGCGs) are benign entities of the jaw with an unknown cause. They are considered nonneoplastic; however, they can exhibit aggressive clinical behavior. The lesions are twice as common in the mandible as in the maxilla and have a predilection for the anterior mandible. Commonly, the lesion crosses the midline. It is seen more commonly in females than in male patients, with variable ratios cited in the literature, but generally, a 2:1 ratio of female to male is accepted. Historically, these have been called giant cell reparative granulomas, but there is little evidence to support the theory of a reparative cause. The lesion commonly is seen in patients between the ages of 10 and 25 years but can be seen at any age. Commonly asymptomatic when they manifest, CGCG lesions often are detected on routine radiographs. If CGCG lesions cause symptoms, they may cause pain and paraesthesia. They can cause displacement of teeth, which may lead to malocclusion. If the cortical plate is perforated, they can manifest as a swelling or an ulceration. The lesions may be separated clinically into 2 categories: nonaggressive and aggressive. Most cases are nonaggressive lesions, which manifest as slow-growing, asymptomatic lesions without root resorption of teeth. Aggressive lesions are painful and rapidly enlarging, with root resorption and cortical plate perforation. Typically, aggressive lesions are larger than nonaggressive lesions and usually are seen in younger patients. Distinguishing between nonaggressive and aggressive lesions typically is based on clinical symptoms and radiographic features.

Conclusion All of the lesions listed may have similar radiographic features, with widely different severance rates and treatment options. We recommend incisional biopsy biopsically in the case of large lesions for an accurate diagnosis and proper treatment planning. All of the diagnoses require long-term follow-up. In the case we reported, we used corticosteroid injections to attempt to shrink the lesion, but it continued to enlarge. The second line of adjuvant therapy was interferon. Because of its adverse effect profile, interferon should be used only in select cases. The lesion in the case we presented was responsive to interferon therapy, diminishing in size, and permitting surgery to be less invasive.

Molecular and Cellular Mechanisms Underlying Cleft Palate in Trps1-/- Mice


Objectives TRPS1 gene codes for the transcriptional repressor TRPS1, which works by binding GATA sequences. Heterozygous Trps1 mutations lead to an autosomal dominant disorder named trichoheirdonopathal syndrome (TRPS). Key features of TRPS involve hair, skeletal, dental and craniofacial abnormalities, including some cases of cleft palate. Mice with heterozygous Trps1 mutation (Trps1+/+ /mice) demonstrate hair abnormalities and high arched palate phenotype similar to TRPS patients. Interestingly, homozygous mutant mice (Trps1-/- mice) exhibit cleft palate. Our objectives were to delineate the role of Trps1 during palatogenesis and identify the mechanism of cleft palate in Trps1-/- mice.

Methods To determine the ability of Trps1-/- palatal shelves to fuse, 24 h in vivo culture of palatal shelves from wildtype (WT) and Trps1-/- E13.5 mice embryos was performed. Immunohistochemistry was used to delineate expression of Trps1 in WT mice. The presence of Twist1, Eomes, and Gata6 proteins important for this process. The presence of each protein was lost in Trps1-/- palatal shelves. Eomes and Twist1 proteins were expressed in palatal shelves epithelium, specifically the medial edge epithelium (MEE) and maxillary mesenchyme. Cspg5, Trps1, Twist1, and Gata6 were detected at E14.5 VVT NIE as well, but dosage was not clear to determine if each protein was lost in Trps1-/- palatal shelves.

Conclusions Our findings indicate that Trps1 is necessary for palatal fusion and expression of other proteins important for this process. The presence of Trps1 in maxillary mesenchyme also suggests that Trps1 plays additional roles in palatal development in addition to fusion.

Early Diagnosis of Periodontal Disease Needs Less Treatment and Prevent Tooth Loss

P. Famili, N. Shah, N. Anzur

Objectives The aim of this study was to measure the number of teeth lost among a random sample of individuals receiving periodontal treatment and to determine long-term follow-up at a university practice.

Methods One-hundred subjects who had received periodontal treatment and had been on recall for three or six months for at least five years, up to twenty years, participated in this study. Subjects had at least twenty teeth. The same periodontist treated all patients. Treatment was scaling and root planing for mild periodontitis, or scaling and root planing plus surgery for moderate to advanced periodontitis; then all patients were on recall three months or six months.

Results 22 men (38.60%) had tooth loss, compared to 37 women (40.22%) who lost their teeth. This was not significant (p=0.84). The difference between patients who had scaling and root planing versus scaling and root planing with surgery was significant (p=0.003). The intercalated recall interval was not significant (p=0.139). After adjusting for age, gender, and recall treatment, all was still statistically significant.

Conclusion This study showed early diagnosis of periodontal disease could be treated more scaling and root planing, with patients losing fewer teeth than treating patients with moderate to advanced periodontal disease by required surgery. Early diagnosis of periodontal treatment needs less treatment and prevents surgery, is less painful, and saves many expenses.

Third Molar Agenesis and Craniofacial Morphology

E. Kalle, Y. Zhou, A. Vierra

Objectives Previously, the relationship between 3rd molar agenesis and particular craniofacial morphology parameters has been widely studied with conflicting results. Furthermore, 3rd molar agenesis has been associated with reduced tooth size and morphology. In this study, we aim to test the null hypothesis: (1) a smaller ANB angle is not associated 3rd molar agenesis. (2) Shorter palatal length is not associated with 3rd molar agenesis. Furthermore, second molar crown formation and first molar root formation complete around the time when third molar development starts; thus to investigate the potential local influence of these events on third molar initiation, we test the association between 3rd molar agenesis and average crown width of second molars, as well as length of first molar roots.

Methods We examined the previously studied ANB angle correlated with third molar agenesis. Panoramic and profile radiographs were obtained from 40 total orthodontic patients from the University of Pittsburgh Dental Registry and DNA Repository. These were divided into two groups: (1) patients that have agenesis of at least one 3rd molar and (2) patients that do not have crowns of at least one 3rd molar. Information on third molar extraction was not available so patients selected are between 10 and 17 years of age where third molars can be expected to be in the process of developing and therefore visible on radiographs. Mesiodistal crown dimensions were recorded by measuring all erupted permanent second molars. The length of the mesial/buccal root on the mandibular and maxillary first molars was measured from the root tip to the cervicale line. The ANB angle is the cephalometric standard for measuring degree of prognathism. This was calculated using the formula SNA-SNB=ANB. The difference between patients who had scaling and root planing versus scaling and root planing with surgery was significant (p=0.025), but the recall interval was not significant (p=0.139). After adjusting for age, gender, and recall treatment, all was still statistically significant.

Conclusion This study showed early diagnosis of periodontal disease could be treated more scaling and root planing, with patients losing fewer teeth than treating patients with moderate to advanced periodontal disease by required surgery. Early diagnosis of periodontal treatment needs less
Hand vs Rotary File Glide Path Creation in Calcified Canals: A Microcomputed Tomography Pilot Study


Objectives To compare the preservation of original canal anatomy when stainless steel hand and Ni-Ti rotary glide path files are used to create a glide path in calcified root canals

Methods 10 roots of anterior deocorated teeth with calcified canals, selected after preliminary digital radiography and microCT scans from a pool of 150 to have matching canal anatomy and calcification pattern, were microCT imaged (110 micron voxel resolution, 60 Kvp, set A). A glide path was created in the canals using either hand files (sizes 15/20 ± 5) or Path files (Dentsply, sizes 1-3, n=5) after an initial preparation with 010 size hand files and root was imaged again (set B). Set A and B volumes for every root were digitally registered and transportation of the canal at 1, 5, and 9mm from the apex was measured.

Results Transportation was not significantly different for any of the locations examined between the hand and Path file group, respectively. The transportation on an average was higher in the hand file vs. the Path file group (p = 0.05 vs. 0.017; 0.05; 0.017; respectively).

Conclusion Non-destructive 3D analysis of canal transportation during glide path creation by stainless steel hand and Ni-Ti rotary glide path files can describe the canal transportation involved in calcified canal cases in a quantitative manner. No significant differences in canal transportation were detected between the glide path creation methods examined and the number of specimens used in the study.

The effect of endodontic access on the compressive strength at fracture of extracted maxillary molars

M. Lentz, S. Khalid, M. Madooni, I. No, A. Maslia, S. Jaber, A. Almarza, H. Ray

Objectives The purpose of this study was to compare the fracture resistance of extracted maxillary molars without access preparation, or with conservative access size, traditional access size, or traditional access size with simulated loss of marginal ridge integrity. The null hypothesis was that there is no statically significant difference in the fracture resistance of endodontically accessed teeth based on size of access.

Methods Forty extracted maxillary molars were used in this study. The teeth were divided into four groups based on access size: group 1 (control, no access); group 2 (conservative access); group 3 (traditional access); and group 4 (traditional access with micro-occlusal preparation to simulate previous restoration or carious resulting in loss of marginal ridge). The teeth were then fractured using an Insta-press machine, and compressive strength and load force at fracture were recorded. Data were analyzed with one-way analysis of variance with significance level set at p = 0.05.

Results No statistically significant differences were observed among the groups regarding load force (p = 0.45) and compressive strength at fracture (p = 0.57).

Conclusion Based on the results of this study, access size did not have a significant effect on load force and compressive strength to fracture endodontically accessed teeth.

Orofacial Pain Assessment of Rats with Bite-Raising Splints

W. Li, X. Liu, J.P. Farans, M. Gold, A. Almarza

Objectives To investigate whether a sudden change in occlusion is associated with the emergence of hypersensitivity in the TMJ area in adult male rats.

Methods Partial hypersensitivity was assessed before and after splint placement with the orofacial pain assay. Rats were trained to access a 5% sucrose solution via a window in the side of the cage. Cumulative contact time (CT) with the sucrose sipper tube was determined for each 10 min training and subsequent testing session. For testing, 18-pin wire arrays were placed in the window to provide bilateral mechanical stimulation of the face when the sucrose solution was accessed. Baseline data were collected 4 days before, 1 day after, and then once per week after splint placement. Splints consisted of dental resin poured to about 1 mm in thickness, which were applied unilaterally to the right maxillary molars.

Results Increase in CT was observed during training, which plateaued by day three. CT was significantly decreased when mechanical stimulation was added (by 80%; p < 0.05). CT was decreased further still following splint placement (by 58% ± 16%, p < 0.05).

Conclusions Our results are consistent with an increased sensitivity to noxious mechanical stimuli following altered TMJ loading. The orofacial pain assay appears to be a sensitive way to quantify changes in peri-ocular mechanical sensitivity. Additional experiments will be needed to confirm that the changes in behavior reflect an increase in nociception.

Malocclusion on the Histology of the TMJ Cartilage of Rats

X. Liu, W. Li, M. Gold, A. Almarza

Objectives We have previously demonstrated that a change in temporomandibular joint (TMJ) loading associated with unilateral splint placement over a maxillary arch is sufficient to drive degeneration of the mandibular condyle in the rabbit. Because of the variety of validated assays of orofacial nociception available in the rat, the objective of the present study was to determine whether it was possible to adopt the splint model of TMJ disorder (TMJD) developed in the rabbit, to the rat.

Methods Rats were anesthetized and sacrificed for histological analysis of the TMJ. The midsaggital section was made through the TMJ, and the right TMJ was removed for histological sectioning. The rats were placed in a prone position on a custom-made stage, and the TMJ was exposed by removing the lateral and medial pterygoid muscles. In addition, 1 mm of bone was removed from the condylar neck to expose the articular surface. The condylar head was then microtomed into 5-7 micron thick sections, which were stained with Hematoxylin & Eosin (H&E), safranin O, Masson's trichrome, and Picrosirius red staining.

Results The TMJ cartilage of rats with malocclusion showed significant alterations in the morphology of the articular cartilage. The articular cartilage was thin and irregular, with increased matrix degeneration and loss of organization. The subchondral bone was also affected, with increased bone turnover and remodeling.

Conclusions These findings suggest that the TMJ cartilage of rats with malocclusion is affected by the altered mechanical loading, similar to the changes observed in the rabbit model. This provides support for the use of the rat TMJ model as a tool to study the effects of altered mechanical loading on TMJ cartilage.

University of Pittsburgh School of Dental Medicine Eighteenth Annual Research Symposium
Results Primary tissue boundaries were detectable on the condylar tip and centrally to the splint placement. These included the fibrous zone, proliferative zone, articular zone, and subchondral bone (Figure 2A). However, for the faint staining around the pericellular area, there was no staining for glycosaminoglycans (GAG) in the cartilage layer (Figure 2B). Collagen was widely stained throughout the condyle (Figures 2C, D).

Conclusions The absence of GAG staining in the condyle is consistent with the presence of joint degeneration. The bilateral nature of the change suggests the impact of an unilateral splint is bilateral. In addition to sham controls, it will be important to further characterize in time course of both the onset and recovery of the changes in the joint and determine the extent to which the histological changes correlate with changes in joint sensitivity.

Analytic Survey of 57 Cases of Oral Metastases
Y. Liu, R.J. Vargo, E.A. Bilodeau

Background Oral lesions have been reported among the first signs of an undiagnosed metastatic disease. Accurate diagnosis of an occult metastasis remains critical in determining the treatment course. Previous studies regarding oral metastatic tumors present varied data relative to the most frequent metastases to the oral cavity. These discrepancies echo the changes in incidence rates for certain malignancies over time and demonstrate the need for periodic updates in oral metastasis studies.

Methods: Using Text Information Extraction System, a de-identified pathology database, we compiled 57 cases over a period of nineteen years using key terms to search for oral metastases.

Results For both males and females, the most common primary sites were lung (21.1%), liver (12.3%), breast (10.5%), kidney (10.5%), and colorectal (8.8%). We found an equal number of lung and breast metastases in females and metastases from the liver to be the most prevalent for males. In most of our cases (54.9%), the patient had no history of the primary malignancy and the oral lesion preceded awareness of the widespread cancer.

Conclusions As a departure from many previous case series, we found lung and breast metastases to be equally numerous in women and men as the most common oral metastasis in men. Also, we identified a tendency for the patient to present with a previous history in certain malignancies, like breast cancer, whereas in other malignancies, such as renal cell carcinoma, our data demonstrated a propensity to present in the oral cavity without history of a primary tumor.

Kidney Disease, Increased BMI, and Restorations on Anterior Maxillary Teeth
C. Littlejohn, Vieira A.R.

Objectives Since enamel defects are more common in individuals with developmental kidney disorders, we tested if individuals with chronic disease have more restorations in anterior maxillary teeth.

Methods Using the Dental Registry and DNA Repository project’s database, statistics on patients’ oral conditions were compared based on systemic conditions. This research was carried out in three settings. The initial was to study the relationship between restoration frequency and kidney disease. The second was to explore the relationship between Body Mass Index (BMI) and restoration frequency. The third was to connect the previous two explorations through studying the relationship between BMI and kidney disease.

Results From the initial experiment, it was found that there was a correlation between kidney disease and increased restoration frequencies. In addition, when the second portion was analyzed, there was a positive relationship between patients’ BMI and their restoration frequency. Lastly, there was a correlation between higher BMI and kidney disease.

Conclusions Patients who have kidney disease will more often need anterior composite restorations that are possibly surrogate of enamel aesthetic concerns or higher caries experience, as compared to the total population of patients in the study. Patients who have higher BMIs tend to have higher restoration frequencies. We found a correlation between kidney disease and patients’ BMI. The identification of individuals with “caries predisposing enamel” not only would allow for personalizing preventive strategies, but also provide support for the popular belief of a correlation between “weak teeth” and having many “cavities.”

Does Drinking Fluoridated Water Correlate with Lower Caries Prevalence in Appalachian Children?
J.L. Prasad, N. Shah, R. Weyant

Objectives This study aims to determine if drinking fluoridated water correlates with a lower caries prevalence in Appalachian children, given competing sources of fluoride in modern society, and accounting for social and economic factors that could influence oral health outcomes. The findings of the study will help guide recommendations for appropriate and effective caries prevention strategies.

Methods The study is based on cross-sectional data from the Center for Oral Health Research in Appalachia (COHRA) etiology study database, and includes information derived from interviews, questionnaires, clinical examinations, and water samples of families in rural Appalachia.

Tests will be used to determine if drinking fluoridated water correlates with caries prevalence in the primary and permanent dentitions in children 10 years and under. Caries prevalence will be based on age-adjusted dmfs and DMFS scores. Linear regression analysis (or Poisson regression) will be used to determine if other variables also correlate with caries prevalence, including socioeconomic factors (parent education and household income), oral hygiene practices, dental history, history of breastfeeding, dental insurance, and access to health information.

Results The study hypothesis is that drinking fluoridated water correlates with lower caries in Appalachian children 10 years and younger, regardless of competing sources of fluoride. The results of the study are still pending.

Conclusion Pending results.

Post Removal-Induced Dentinal Crack Formation by Modern Ultrasonic or Mechanical Force Systems: A Microcomputed Tomography Pilot Study

Objectives To compare the incidence of dental cracks generated during post removal through modern ultrasonic tip instrumentation and mechanical force systems to reports from an earlier study [Althshul et al, JOE 1997].

Methods Roots from 10 human maxillary central incisors and canines of similar canal diameter and shape were instrumented using the EdgeFit K3 system, followed by the preparation of the coronal 8mm with a Parapost drill & # and were imaged by high resolution microCT (set A: 10micm voxel resolution, 60 kVp). 10mm long Parapost posts of the same size were cemented ( Fuji 2 luting system) in the prepared spaces. Posts were removed after a week using either an ultrasonic tip under water cooling (n=5) or the Ruddle post removal system (Kari Dental, n=5). MicroCT imaging of the roots was repeated with same conditions (set B), and the presence, number and location of dental defects was recorded. Defects observed in set A or inflated in the dentinal wall periphery were not included in the final results.

Results One complete and one incomplete crack (both around the cervical 3mm of post space) were detected on one specimen (Ruddle post removal system group), while all other were crack-free.

Conclusion Post removal using either ultrasonics or based on the original Gonan modern systems
Phosphate Alters Protein Composition of Extracellular Vesicles (EV) Released by Odontoblasts


Objectives “Extracellular vesicles” (EV) is a collective term used for a variety of lipid membrane-enclosed particles of sub-micron size, which are released by cells to the extracellular space. Molecular composition of EV is thought to reflect the function of EV. A subset of EV released by osteogenic cells are matrix vesicles and are thought to be sites of mineral nucleation. In our previously published research we observed that phosphate treatment of odontoblasts elicited increased release of EV. The aim of the current study was to determine the molecular composition of the EV released and if phosphate treatment alters their composition.

Methods Mouse predontoblast-derived 17IIA1 cell line was treated with 10mM of sodium phosphate or water in 10% exame-depleted FBS-DMEM medium. EV was collected from medium and extracellular matrix using differential ultracentrifugation, quality was assessed by silver stain and cryo-electron microscopy. Mass spectrometry analysis was performed on 4 groups of vesicles: Control vesicles from either medium or extracellular matrix (ECM) (w/ or w/o phosphate treatment) and Phosphate vesicles from either medium or ECM (Pi-treated, P-ECM). Gene ontology was used to analyze mass spectrometry results. Western blot analysis and qRT-PCR were used to evaluate protein and mRNA, respectively.

Results We found 1164 proteins total from all 4 groups analyzed, with 302 (26%) of all proteins shared between all 4 groups. 30% of total proteins were unique to ECM and 14% were unique to medium groups. Pi-ECM group had the greatest number of unique proteins (22% of proteins detected within this group) and Pi-mediated had the smallest number (6% of proteins detected within this group). Between medium groups, phosphate significantly altered levels of 75 (16%) proteins, 45 were decreased and 30 were increased. Between ECM groups, phosphate significantly altered levels of 207 (40%) proteins, 117 were decreased and 100 were increased. These changes in vesicle composition were not linked to RNA expression changes. Finally, pathway analysis revealed N- and O-glycosylation as being pathways significantly decreased by phosphate treatment in ECM.

Conclusions Our results indicate for the first time, EV released into the medium and ECM are separate populations. We have also shown that phosphate significantly alters the composition of EV released.

Retrocuspid Papilla: A Series of Forty-three Cases
T. Stansbury, E. Blodseau

Objectives We present a case series of recuspid papillae (RCP), an entity seen in up to 99% of children, known to regress with age to a prevalence of 19% of older adults. The RCP is thought to be a variant of normal anatomy or a developmental anomaly present at birth, enlarging during childhood and adolescence and involuting during adulthood. Some believe it develops as a mass due to the unique position of the permanent and primary mandibular canine. Clinically, it may mimic pathologies, prompting biopsy. The goal of this research was to determine the frequency of regression, clinical features, and differential diagnoses.

Methods Case information was collected from the University of Pittsburgh Oral Pathology Biopsy Service archives (1998-2016). The clinical and primary mandibular canine. Clinically, RCP may be a process that incurs a significantly lower cost compared to other surgical procedures, as it may be a process that incurs a significantly lower cost compared to other surgical procedures.

Results We present a series of 43 cases of RCP in the anterior mandibular gingival area. 52.4% of the patients were older than 20. Bilateral involvement was present in only one case. Clinical descriptions included asymptomatic (43/43, 100%), firm (20/43, 46.5%), and pink (19/43, 44.2%). Clinical impressions included fibroma (23/43, 53.5%) and papilloma (9/43, 20.7%). More than one clinical diagnosis was provided in five cases. The average size was 0.41cm (range 0.15-0.8cm).

Conclusion Only one of 43 cases had a clinical diagnosis of RCP. Thus, clinicians should be made aware of the under-recognized entity in adults. 97.2% of our cases were unilateral, suggesting that only asymmetrical cases are biopsied. The lack of RCP regression could lead to misidentification as pathosis by clinicians, prompting unnecessary biopsy of an anatomic variant.

TNAP Is Involved in Odontoblasts Response to Phosphate
B.T. Chae, D. Monier, S. Khalid, V. Smethurst, D. Napierala

Objectives Mutations in the TRSPl gene causes Tricho-Rhino-Phalangeal syndrome manifesting with dental and skeletal abnormalities including impaired mineralization. We have shown before that recombinant TNAP deficient odontoblasts exhibits impaired mineralization through the down regulation of mineralization genes. One of them is tissue-nonspecific alkaline phosphatase (TNAP). This enzyme hydrolyses pyrophosphate (Pi), which is a major inhibitor of mineralization, ultimately providing odontoblasts with the necessary phosphate (Pi) for mineralization. Based on the expression pattern and its role in dentin mineralization we hypothesize TNAP deficiency is the major cause for the loss of mineralization potential in TRSPl deficient odontoblasts.

Methods Previously generated Trps-1 deficient odontoblasts cell lines (17IIA1) were used to restore TNAP expression through transposon-mediated genomic integration of a TNAP-expressing construct. These TNAP restored cell lines were generated. TNAP expression was analyzed by quantitative reverse transcription PCR (qRT-PCR). Analyses of expression of mineralization related downstream target genes.

Results: Three clonal cell lines expressing same levels of TNAP as unmodified 17IIA1 cells were chosen. TNAP restored cells showed an increase in mineralization, in comparison with Trps1-KD cells. However, Trps1 expression has not changed. Analyses of expression of mineralization related genes revealed that restoring TNAP expression significantly up-regulated expression of PTHr1, Smad4, Phospho, Runx2 and SP7 (Cola) in comparison with Trps1-KD cells.

Conclusion TNAP plays a critical role in TNAP-regulated mineralization by improving cellular response to phosphate and expression of downstream target genes.

Oral Health Status and Dental Utilization Differs by Rurality in Appalachia

Objectives This study determined how rurality correlated with access to dental care, oral health behaviors, and oral health status among adults living in northern Appalachia.

Methods Participants were Appalachian resident adults aged 18-59 (n=1089) from the Center for Oral Health Research in Appalachia (CORA) Rural-Urban Continuum (RUC) codes corresponding to the GIS coordinates of participants’ residences were used to classify participants as metropolitan or nonmetropolitan (i.e., small town and rural) logistic and linear regression were used to estimate the association of rurality with measures of oral health status, dental care utilization, oral health related behaviors. Models were adjusted for socio-demographics variables such as age, sex, race, income, and dental insurance.

Results: Nonmetropolitan residents exhibited fewer sound teeth (β=-1.71, p<0.001), more white-spot carious lesions (β=0.65, p<0.0005), higher rates of gingival recession (OR=4.0, p=0.012), and higher rates of complete edentulism (OR=2.8, p=0.017). Likewise, differences in dental care utilization behaviors were observed between nonmetropolitan and metropolitan residents for II
of 9 utilization measures tested (all p<0.0005). For example, nonmetropolitan residents were less likely to go to dentist for routine checkups (OR=0.4, p<0.00001) and were more prone to seek care only after experiencing a dental problem (OR=2.2, p<0.00001). These differences were not explained by socio-demographic variables. However, nonmetropolitan residents were more likely to report “costs too high” (OR=6.0, p<10^-12) as a major reason for not utilizing dental care services. The oral health related behaviors of brushing, flossing, and using mouthwash did not differ significantly by rurality.

Conclusions After adjusting for socio-demographic variables nonmetropolitan resident adults in Northern Appalachia were found to differ significantly from metropolitan resident adults with respect to their oral health status and utilization of dental services. This finding suggests that rurality is associated with risks to oral health that may need to be explicitly addressed through targeted disparity reduction interventions.

Prevention of Inflammatory Bone Loss Via Induction of M2 Macrophages
Z. Zhuang, S. Yoshizawa, M. Shehabeldin, C. Sfeir

Objectives To assess the effect of local induction of M2 macrophages in modulating the immune response and preventing alveolar bone loss in murine periodontitis models.

Methods We first encapsulated the M2 macrophages inducing C-C motif chemokine ligand 2 (CCL2) in poly lactic-co-glycolic acid (PLGA) microparticles (MPs) using double emulsion technique and determined the release profile of CCL2. Next, we assessed the ability of CCL2 to induce the polarization of mouse derived macrophages toward the M2 phenotype and to inhibit the expression of TNF-alpha by RAW 264.7 cells treated with P. gingivalis lipopolysaccharide. Finally, we locally delivered the CCL2 MPs into the gingival tissues of mice where experimental periodontitis was induced and assessed alveolar bone loss, osteoclasts number and the expression of inflammatory and the M1 and M2 macrophages markers.

Results We successfully fabricated recombinant mouse CCL2 releasing PLGA MPs that continued to sustainably release CCL2 for up to 70 days. Moreover, we demonstrated that mouse macrophages treated with CCL2 enhanced their expression of the M2 macrophages surface marker CD206. Additionally, CCL2 was able to reduce TNF-alpha expression in LPS treated RAW cells. Using mouse experimental periodontitis models, we showed that local delivery of CCL2 MPs resulted in significant inhibition of alveolar bone resorption that was positively correlated with a reduction in the number of osteoclasts. Immunostaining for the M1 and M2 macrophages surface markers revealed that CCL2 MPs injection skewed the M1/M2 ratio in the periodontium toward an M2-polarized profile. Finally, our qPCR results showed significant increase in IL1ra mRNA expression and decrease in RANKL mRNA expression in maxillae where CCL2 MPs were injected.

Conclusions We conclude that local delivery of CCL2 skewed resident macrophages towards the anti-inflammatory M2 phenotype and inhibited alveolar bone loss in mouse periodontitis models. This approach could serve as a promising immunomodulatory strategy for treatment of periodontitis.

ACT ARCO Students
Madiha Bhatty
Approaching a New Career: Academic Dentistry
Surbhi Chandna
Making it Unique: Fundamentals of Teaching and Learning in Dental Education
Samiya Jabir
An Unlikely Journey into Teaching
Saniya Kamran
Wearing Both Shoes: A Reflection of Experiences in Academic Dentistry as a Student being the Teacher
Ashley Lazar
Teaching to Create Good Students: Exploring Ways to Help Students Get the Most of their Education
Giana Lupinetti
Pursuing a Career Path That Merges Clinical and Academic Dentistry
Katherine Ni
Building Intentional Dental Educators


Benish E. Co-option of hair follicle keratins into amelogenesis is associated with the evolution of primatic enamel: A hypothesis. Front Physiol 2017;8:823.


Genotype and phenotype correlation of dental caries susceptibility in pachyonychia congenita-associated keratins


pachyonychia congenita-associated keratins


pachyonychia congenita-associated keratins


pachyonychia congenita-associated keratins

2017 American Academy of Oral Implantologists (ICOI) Winter Implant Symposium
New Orleans, La.
February 16-18, 2017

McGaw Institute for Regenerative Medicine Annual Scientific Retreat
Pittsburgh, Pa.
March 5-7, 2017

95th General Session of the International Association for Dental Research
San Francisco, Calif.
March 22-25, 2017

2017 National Rx Drug Abuse & Heroin Summit
Atlanta, Ga.
April 17-20, 2017

2017 American Academy of Oral and Maxillofacial Surgeons Annual Meeting
April 26-29, 2017

Geistlich Biomaterials Symposium—Multidisciplinary Treatment Solutions for Peri-Implantitis
Chicago, Ill.
June 6-9, 2017

American Academy of Dental Medicine Association (AADA) Annual Meeting
Baltimore, Md.
June 6-8, 2017

American Academy Commission on Change and Innovation in Dental Education (AEDA CCE) Liaisons Summer Meeting
Baltimore, Md.
June 8-9, 2017

American Academy of Periodontology (AAP) 103rd Annual Meeting
Boston, Mass.
September 9-12, 2017

American Dental Association 2017 (ADA)
Atlanta, Ga.
October 1-14, 2017

American Academy of Oral and Maxillofacial Pathology (AAOMP) Annual Meeting
Newport, R.I.
October 17-21, 2017

American Academy of Maxillofacial Surgery 2018 Annual Meeting
Phoenix, Ariz.
March 17-23, 2018

American Society of Human Genetics Annual Meeting, Scientific Sessions and Exhibition
San Francisco, Calif.
November 13-17, 2017

47th Annual AADR Meeting & Exhibition/42th Annual CADR Meeting
Fort Lauderdale, Fla.
March 21-24, 2018

American Cleft Palate—Craniofacial Medicine (AAOMP) Annual Meeting
San Antonio, Tex.
April 26-29, 2018

Pennsylvania Society of Oral and Maxillofacial Surgery 2018 Annual Meeting
Hershey, Pa.
April 29-30, 2018