UNIVERSITY OF PITTSBURGH SCHOOL OF DENTAL MEDICINE

NINETEENTH ANNUAL RESEARCH SYMPOSIUM 2019

PITT DENTAL MEDICINE IN THE TOP FIVE FOR NIDCR FUNDING

Pitt Dental Medicine maintains it's **number four** ranking for National Institute of Dental and Craniofacial Research (NIDCR).

The profound research performed at Pitt Dental Medicine is responsible for maintaining a 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 premiere 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 **Costello** 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 **Marazita** 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*

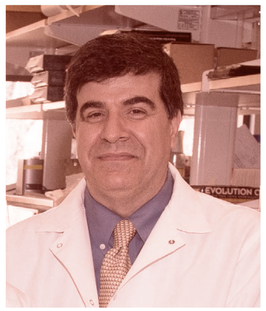
"The School of Dental Medicine's ranking is an indication of its prominence in both dental research and in the training of new dental professionals. The school's success reflects our campus-wide commitment to excellence at the University of Pittsburgh. I congratulate Dean BJ Costello and all of the school's 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*

FISCAL YEAR	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Rank	29	26	25	27	16	17	13	16	12	6	7	17	9	7	9	4
Total Research Funding	$1,181,857	$1,775,222	$2,399,980	$2,290,222	$3,372,723	$3,050,028	$3,795,400	$3,261,491	$4,694,478	$6,260,761	$5,929,316	$3,142,305	$4,832,404	$5,143,805	$6,275,394	$8,487,933

Mary **Marazita** PhD

Director of the Center for Craniofacial and Dental Genetics



Charles **Sfeir** DDS PhD

Director of the Center for Craniofacial Regeneration

RESEARCH SYMPOSIUM HISTORY

In 2000, the research taking place at the School of Dental Medicine was not necessarily reflective of a school of this prominence. Dr. Mary Marazita became the Associate Dean for Research and drafted a vision to encourage research efforts through the first School of Dental Medicine Research Symposium.

After 19 years, it has become the longest-running research symposium at Pitt—and with good reason.

Including significant speakers from outside of Pitt greatly expanded this inspiring traditions and the event continued to grow in attendance and significance. Concurrently, NIH funding to the school increased to more than $5 million by 2013.

Pitt Dental Medicine has become a significant force in dental medicine research.

Since 2013, Dr. Charles Sfeir, new Associate Dean for Research, continues to expand and improve the symposium. Newly identified funding, such as the Michigan-Pittsburgh-Wyss project, is influencing the power of translational research here at Pitt.

And Pitt Dental Medicine is influencing research worldwide.

Recognizing the needs of clinicians to answer the question "what can research do for me?" the 2019 Research Symposium showcases advancing clinical treatments made possible through the research in biomineralization taking place right here. Pitt Dental Medicine recognizes the power of presenting sensible clinical information in a continuing education format to bring relevance and practicality to research.

Innovation intensifies the power and influence of the Annual Research Symposium, enabling it to thrive and successfully become the most dynamic and progressive dental research symposium in the region.

DEAN'S MESSAGE

Dear colleagues and friends,

It is my honor to welcome you each to the Nineteenth Annual Pitt Dental Medicine Research Symposium. This is a day not only to share and celebrate our accomplishments, but an opportunity to look ahead to what the future holds for us. Research holds an essential position in our success as a school. It is a privilege to see this event come together, with each year's symposium building on the success of those in the past. I hope that you look forward as much as I do to learning about the exciting work happening at the University of Pittsburgh School of Dental Medicine.

As always, with this event, we turn our attention to not only the achievements of our researchers, but also to the important role that our students and clinicians play at the school. All play a vital role in our the realization of our goal of being an institution dedicated to offering the best that dentistry and craniofacial biology has to offer. The intersection of research, academics and patient care is a crucial one, as all three support and feed into the success of one another. This day exemplifies that unity of achievement with its outstanding presentations, opportunities to enhance our knowledge and occasions to give voice to ideas of our own.

I encourage everyone to take this day as a chance not only to learn about our latest advances, but to consider how research and innovation relates to you and enriches the lives of others. Our profession shares the common goal of improving the health and quality of life for individuals. It is this aim that ultimately drives our research enterprise—at its heart, our research is about striving to better the lives of as many as we can. This is the secret to our success as researchers, scholars, teachers and clinicians. It is evident in the passion with which those at Pitt Dental Medicine provide care and pursue innovative discoveries--and I am proud to be a part of it.

Sincerely,

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

"...at its heart, our research is about striving to better the lives of as many as we can."

Bernard J **Costello** DMD MD
Dean

ASSOCIATE DEAN'S MESSAGE

Charles **Sfeir** DDS PhD
Associate Dean for Research

Dear Pitt Dental Medicine friends,

I am honored to welcome you to our Nineteenth Annual Research Symposium at the University of Pittsburgh School of Dental Medicine. There are many successes we are fortunate to be able to highlight this year. I would like to first put the spotlight on the changes we are implementing this year to our Research Symposium through the assembl y of an exciting clinical and basic research program that showcases our clinical and research strength.

We not only have much to celebrate this year, but a great opportunity to learn about how the dental field is rapidly advancing toward a bright future.

Research is unquestionably a priority at Pitt Dental Medicine, as demonstrated by our consistent ranks as a top-ten dental school for National Institute of Dental and Craniofacial Research (NIDCR) funding. Our prominence as a research institution does much more, however, than establish our standings in the national rankings—it advances the field and, most importantly, improves the lives of our patients.

The strength of our research program is realized in the collaborative and innovative approaches undertaken by our faculty. Our collaborative research spans basic sciences to translational research. This strength is evidenced by the many funded research projects at Pitt Dental Medicine.

"Our Symposium today is designed to celebrate the achievements of our investigators, introduce to clinicians the latest advances and support our students as they make their way into the exciting worlds of both patient care and research."

Allow me to highlight a couple of these programs:

- an international inter-University collaboration that focuses on genetic variants influencing facial features and their development, led by the Center for Craniofacial and Dental Genetics, which also continues its studies of oral health in Appalachia and cleft and lip palate;

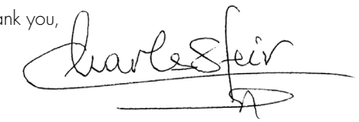
- Michigan-Pittsburgh- Wyss Resource Center: Supporting Regenerative Medicine in Dental, Oral and Craniofacial Technologies, led at Pitt by our Center for Craniofacial Regeneration, which is now supporting promising projects from the clinical, academic and private sectors, bringing new technologies one step closer to patients.

Our research programs are built on many of the research strengths at the University. To be part of such a research-intensive institution and share in the collaborative efforts of research faculty, clinicians and students is a privilege for me and the others who are passionate about the research we do each day. Our aim is to not only share knowledge, but enhance the bonds between us as scientists, clinicians and dentists. Our Symposium today is designed to celebrate the achievements of our investigators, introduce to clinicians the latest advances and support our students as they make their way into the exciting worlds of both patient care and research.

I am pleased to have presenters at our symposium from within the school who can attest to the power of collaborative efforts. It is also a great pleasure to welcome our keynote speakers, Drs. Frank Tay and Steven Bloembergen, whose innovative approaches in research are an inspiration to many. They both used biomineralization principles to develop novel therapies, but for different purposes.

As we keep our sights focused on a vision of innovation and excellence that encompasses all aspects of the school, a better understanding of the inner workings of dental genetics, pioneering new technologies and our collective effort to improve clinical practice should be a point of pride for us all.

Thank you,



HARNESSING BIOMINERALIZATION

By: B. Rose Kelly and James Rosendale

There are already a number of approaches dentists can use to improve dental health. Significant advances are being made in the field of biomineralization— the process by which living organisms deposit minerals in their tissues. Many of these advances apply to routine dental applications such as caries management, tooth whitening and restorative treatments (remineralization of natural tooth material where it abuts filling material). In addition, understanding biomineralization may provide the foundation for advancements in engineering novel biomimetic materials (engineered solutions that mimic naturally occurring tissues)

Internationally renowned, Pitt Dental Medicine researchers are conducting cutting-edge research into biomineralization, allowing them to develop novel clinical treatment solutions while educating the next generation of dentists with innovative curricula. Shepherding a new wave of biomineralization research, teaching and clinical treatments, the faculty, staff and students at Pitt Dental Medicine have a unified goal: preserving teeth while doing as little invasive dentistry as possible.

Revealing Essential Knowledge about Biomineralization

Mineralized tissue, such as animal shells, bones or teeth, is one of the hardest tissues in nature. Teeth, specifically, are composed of three types of mineralized tissues: dental enamel, the hard, outer layer; dentin, which forms the bulk of the tooth; and cementum, a calcified surface that covers the root of a tooth.

All tissues in the tooth are susceptible to an attack by environmental conditions, and a number of genetic factors increases or decreases this susceptibility. Even though dental enamel is the hardest substance in the body, it has little ability to repair itself when it is damaged. This is why toothpaste advertisements often tout strengthening this area of the tooth, which helps to protect the layers underneath.

But what if those things that cause tooth decay could be discovered before they ever became established? Pitt Dental Medicine clinicians and researchers are collaborating to establish clinical processes and curricular changes to better educate patients about tooth whitening, improve caries early detection and treatment (management) and achieve improved adhesion at the interface in restorations and the study of biomineralization is the key.

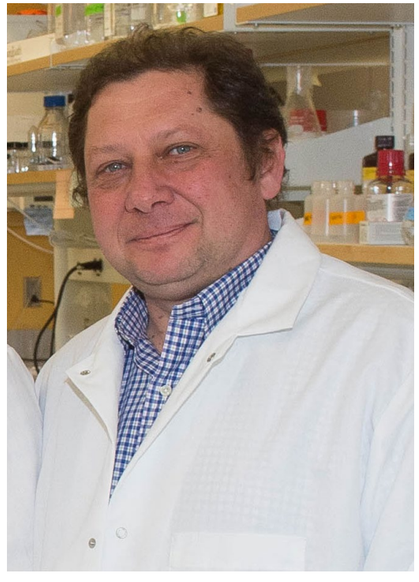
Among the leaders in this area is Dr. Elia Beniash, a professor in the Department of Oral Biology with a joint appointment in Pitt's Department of Bioengineering. He has conducted a number of studies related to biomineralization thanks to

financial support from the National Institutes for Health (NIH) and the National Science Foundation.

Dr. Beniash's research interests include biomineralization, the structure/function relationships in supramolecular assemblies, bioinspired materials and tissue engineering. His work focuses on understanding basic mechanisms of mineralization in biological systems and applying these strategies to the design of new, nanostructured composite materials for biomedical and other technological applications.

Learn more about Dr. Beniash's research by visiting **dental.pitt.edu/research**.

"Because many of the tissues that dentists work with are mineralized, understanding biomineralization principles is essential if we are to develop new bioinspired materials for mineralized tissue repair and regeneration. A thorough understanding also will contribute to the development of regenerative therapies," said Dr. Beniash, who also is a faculty member in the Pitt Dental Medicine Center for Craniofacial Regeneration (CCR), the McGowan Institute for Regenerative Medicine at the University of Pittsburgh (MIRM), and the Clinical and Translational Science Institute (CTSI).



Elia Beniash, PhD
Professor and Interim Chair
Department of Oral Biology

Dr. Beniash became interested in biomineralization early in his career. The feature of his PhD thesis was a study of sea urchins, which are thought by many to be the key to unlocking the mysteries of biomineralization. These spiny echinoderms have unique biological ways of transforming calcium carbonate into hard shells and spines, making them useful tools for understanding how soft tissues harden over time.

After completing his PhD, Dr. Beniash joined a materials-chemistry laboratory to explore the nanomaterials inspired by biomineralization. Over the years, he worked on different biomineralization systems and his current primary focus is on the biomineralization of tooth enamel and the shells of bivalve mollusks.

While these toothless sea animals may seem far removed from the dental field, they are an interesting general concept and knowledge gained through studying them may be applied to the human world as well, Dr. Beniash explains. Oceanic acidification erodes mollusks shells in the same way that acidic soft drinks damage dental enamel.

"All organisms, including humans, have a limited amount of energy and materials (such as tissue) for survival and growth. As both animals and humans have and continue to evolve, trends of evolutionary trade-offs occur—where one specialized trait is developed at the expense of another," Dr. Beniash said.

Dr. Beniash explored these evolutionary differences in two closely-related species of oysters from the Pacific and Atlantic Oceans. These oysters at one time were relatively close cousins but ended up choosing different traits during their evolution, utilizing separate strategies for survival.

He was drawn to this work after publishing a paper in 2010, which showed that as carbon dioxide increases in parts per million, it dissolves into water, becoming a carbonic acid, which in turn lowers the pH levels in the ocean. Given that animals build their shells from calcium carbonate, Dr. Beniash wondered how these oysters might respond to such a change. Similar to the erosion of teeth when they are in contact with an acid, oyster shells erode when the acidity in the water increases.

What he found was that one species developed a stronger shell to ward off predators, while the other species developed a strong innate immune system to help fight infections—trade-offs between immunity and biomineralization between these oyster cousins.

Given this, one species has a higher chance of survival in an environment with a high density of predators; another species has a better chance to survive biologically.

"While not directly tied to dental research, the findings are still relevant. Erosion by acidity is common throughout the animal kingdom and among humans, and the process of biomineralization is the same in either source. We see this similarity throughout different species and classes," Dr. Beniash explained.

Currently, Dr. Beniash is leading a few studies regarding the mechanisms of bone formation and enamel at the nanoscale. The findings will be informative for the development of novel bioinspired nanocomposite structures, which can be used in mineralized tissue repair and regeneration.

As every biological process occurs in a highly regulated manner, it's important to understand the molecules involved in the biomineralization of enamel, which is why other Pitt Dental Medicine clinicians and researchers are looking at the gene variations associated with mineralization defects. The goal is to make connections between these variations and changes in the structural and mechanical properties of enamel, as well as the susceptibility of enamel to caries.

Pitt Dental Medicine research faculty include Dr. Elia Beniash, Dr. Charles Sfeir, Dr. Robert Weyant and Dr. Mary Marazita.

In this vein, Dr. Beniash recently completed an enamel study with Dr. Mary L. Marazita, director of the Pitt Dental Medicine Center for Craniofacial and Dental Genetics (CCDG), and professor in the Department of Oral Biology.

Through this mutual work, they were able to show that one of the keratins found in hair follicles also plays an important role in enamel structure and mechanical properties. This protein influences the hardness and structure of enamel, so if a patient has a certain variant of keratin, he or she might have less hard teeth and therefore be more susceptible to cavities.

How this happens is particularly interesting, Dr. Beniash said. Typically, there are proteins that are responsible for cell function which remain within the cell, and there are proteins that are meant to be secreted. The secreted proteins leave the cells and form extra cellular matrices, such as biominerals, bones, dentin and enamel.

Dr. Beniash and Dr. Marazita also found this keratin protein in the enamel matrix, meaning the protein was outside of the enamel. So, if this protein malfunctions, which causes mechanical and structural changes, then the enamel becomes susceptible to caries. The compromised mechanical properties of enamel result in more cracks, which can facilitate progression of caries. Similarly, structural imperfections of enamel—compromised packing of the crystals or voids in the enamel—also can lead to a faster caries progression.

"We can use this knowledge in multiple ways. Once individuals who have a higher susceptibility to caries are identified, dentists can change their prophylaxis and treatment procedures, for example, having more frequent checkups or applying fluoride varnishes more often," Dr. Beniash said. "This knowledge also can be used to develop novel bioinspired materials for enamel repair."

Discovering More Using DNA

Dr. Marazita collaborates with colleagues throughout the United States and in more than 15 countries. She has grant support totaling about $6 million annually, mostly from the National Institute of Dental and Craniofacial Research (NIDCR). She is engaged in exploring a variety of dental disorders with some overlap in biomineralization and is focused mostly on understanding the development of caries to create better preventive treatments.

DNA samples from research study participants provide Dr. Marazita and her colleagues at the CCDG the basic knowledge to explore genetic contributions to common craniofacial and dental traits, including facial birth defects, tooth decay, malocclusion and periodontal disease. Dr. Marazita's team extracts microbial DNA from saliva, tooth surfaces and other locations in the mouth to understand the contribution of bacteria to dental diseases. Further, the CCDG collects important information about a large range of environmental and behavioral factors that affect oral health and disease, such as diet, how frequently a person brushes his or her teeth, if fluoride is in the water that they drink regularly, and components of socioeconomic status.

Learn more about Dr. Marazita's research by visiting **dental.pitt.edu/research**.

"It has long been known that different people have unique susceptibilities to oral diseases such as tooth decay (dental caries) based on genetics as well as environmental and socioeconomic impacts. Some people never get caries while some have caries in all of their teeth. We utilize a variety of approaches to tease out individual risk factors including genetics, microbiology, and behavioral science" Dr. Marazita said.

Dr. Marazita and Dr. Beniash also have performed microhardness tests of the teeth, as well as using microscopy tools to look at the physical structure of enamel. These approaches are leading them to a deeper, more thorough understanding of these concepts, which are important to the disorders they study.

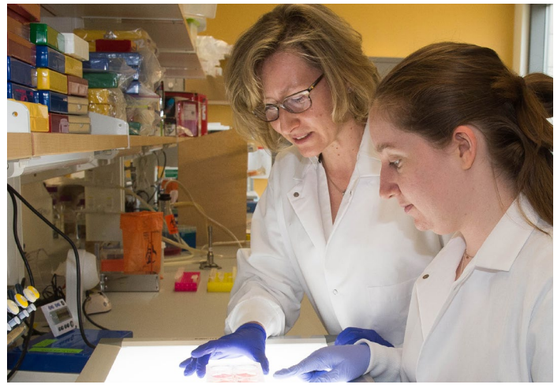
"The process that contributes to caries in the teeth is also happening in the bones. While some genes are specific to teeth versus bones, the demineralization process is the same for both. The ongoing loss of minerals in these tissues can have severe health consequences, which is why we're so profoundly interested in learning ways to manage biomineralization and provide new treatment options for clinicians," Dr. Marazita said.

In terms of treatment, fluoride has been one of the most important health advances in the past century and has successfully reduced tooth decay, Dr. Marazita says. Yet, more work is needed to understand decay that happens even when fluoride treatments are used.

"As we continue to see that additional genes are important, understanding what those genes are gives us a better understanding of what contributes to the formation of teeth—strong and dense enamel and bones. Knowing those molecules can allow us to develop more topical treatments that could help teeth stay mineralized. We could find treatments that will augment fluoride," Dr. Marazita says.

One Pitt Dental Medicine researcher working on the molecular level is Dr. Dobrawa Napierala, an associate professor in the Department of Oral Biology. She relocated to Pittsburgh a couple of years ago specifically to conduct this work together with colleagues who have a complementary expertise in biomineralization. The ultimate goal of Dr. Napierala's research is to translate her fundamental research findings into therapeutic approaches for the regeneration and repair of skeletal and dental tissues. "Pitt Dental Medicine is unquestionably a leader in the area of biomineralization research. If you go to any international meeting focused on the subject, we are very well represented," Dr. Napierala said. "It's truly the strength of the school and why I moved here—to be part of the multidisciplinary team leading this effort."

Learn more about Dr. Napierala's research by visiting **dental.pitt.edu/research**.



Dr. Dobrawa Napierala and Victoria Smethurst

Dr. Napierala looks at biomineralization from a biological perspective, studying how tissues are formed. Her work investigates which biological factors regulate the positioning of the minerals, what molecules regulate when mineral is deposited into the tissue, and how genetic factors may alter that process or cause it to become abnormal. "An extensive understanding of these molecular factors will permit us to manipulate the process and allow us to design methods that will enhance mineralization. This is the whole genesis of my work," she said.

While Dr. Napierala's primary interests lie within the mineralization of skeletal tissue, she's expanded her research toward dentin given the need for research in this area of dentistry. In her laboratory, she studies genetically modified mice as models of human diseases, allowing her and her team to approximate the processes behind many human diseases, including caries. This work is especially helpful for developing treatments. Dr. Napierala also performs in vitro modeling to better understand how these cells respond to different interactions.

Going forward, she hopes her research and the work of others will lead to innovations in tissue regeneration. "The knowledge we're gaining from the research here to drive the repair mechanics could lead to new discoveries in restorative dentistry. For example, clinicians one day could put bioactive materials designed specifically to stimulate cells to make the right tissue. Such tissue regeneration approach could significantly lower dental decay incidence and increase retention of healthy teeth," she said.

Early Detection and Prevention Pathway

On the preventive side, Dr. Charles Sfeir, an associate professor in the Departments of Periodontics and Preventive Dentistry, Oral Biology and Bioengineering, and holding positions within CTSI and MIRM, is investigating bone and dentin tissue engineering, biomaterials and cellular strategies used to regenerate mineralized tissues, and the modulation of the immune system to develop therapies for periodontal disease.

Dr. Sfeir, who is especially interested in bone proteins and how to properly mineralize tissue, investigates the enzymes associated with phosphates, a chemical derivative of phosphoric acid. Calcium phosphate materials are used often in dental applications involving cements, composites and coatings.

Dr. Sfeir's laboratory anticipates that the materials developed within the lab will move into FDA review and clinical trials and as such operates "Good Laboratory Practice" (GLP), an environment necessary for such review.

When looking at the first layer of bone or teeth, it usually consists of smooth surface of collagen. Under that is a specialized layer that is negatively charged, which glues the entire tooth together in one block. When preparing a tooth for a restoration, collagen fibers can often protrude from this surface. This becomes the weak point of interface between the restorative material and hard tissue.

Learn more about Dr. Sfeir's research by visiting **dental.pitt.edu/research**.

Through biomineralization, Dr. Sfeir and others are working to ascertain what can be done to make this interface stronger. It's quite similar to the work of Dr. Beniash.

Charles Sfeir DDS PhD
Associate Dean for Research
Associate Professor
Department of Oral Biology
Chair
Periodontics and Preventive Dentistry

Because detecting an early lesion can be difficult, a number of researchers, including Dr. Sfeir, are working on ways to stop caries before they develop. Generally, the entire field of dentistry is moving in this direction, he said. Studies in biomineralization provide a direct and immediate route to stopping caries before they can get a strong hold since remineralizing the surface of the tooth has been proven in the labs to treat nearly all of the issues related to decay.

Cooperating To Teach Future Clinicians

There are some unique innovations being used at Pitt and some other institutions. Dr. Sfeir said. Dr. Daniel Bloomenberg of Norfolk, Virginia, the keynote speaker at Pitt Dental Medicine's 19th Annual Research Symposium, developed a mouth rinse that will cause early lesions to glow when used allowing dental care providers to address them before they become less manageable. While it is not yet on the market, these are the kind of innovations researchers at Pitt and elsewhere are developing.

On a broader scale, studies related to biomineralization are intensely important to and must always consider our overall physical health, since all minerals used as a treatment or ingested make their way into our bloodstream. When a person's levels of ions drop, they must retrieve it from the bone. Our biological system says, "Hey, I'm down on calcium. Let me go get some from the bones." When there is enough of the mineral ions present, our body will redeposit it back into the bone. All of these deposits and removals are a normal part of our physiology and are needed for our livelihood, Dr. Sfeir said.

This translates directly to the curriculum being implemented by Pitt Dental Medicine Department of Dental Public Health. Leading this important and significant effort is Dr. Robert Weyant, Associate Dean of Dental Public Health and Community Outreach and professor and chair in the Department of Dental Public Health.

Dr. Weyant and others are implementing a new curriculum that encourages students to look for very early dental decay and consider simple, early treatment options rather than rely upon restoration after caries has damaged the tooth. The goal of such a change? To inspire students to practice comprehensive and consistent evidence-based approaches to dentistry.

Because dental decay is a slow process, it takes years for decay to get to the point where a tooth needs a restoration. Typically, dentists are trained to be surgically oriented—using hand pieces to cut away tooth tissue as the routine treatment for decay. Yet, this is an acute management approach to a chronic disease process (e.g., dental caries). Restorations (fillings) do nothing to stop the overall disease process. Thus all patients with caries or at risk for caries need disease-based interventions such as frequent fluorides, sealants and other approaches aimed at arresting the disease process. Cutting away tooth tissues should generally be considered as the last resort.

This conservative, disease-management approach is being heavily emphasized in the new cariology curriculum at Pitt Dental Medicine. Instead of monitoring a lesion's progress over time, Dr. Weyant and others want dental students to focus on stopping the caries disease process. The goal is to use the materials and products that remineralize early decay, ultimately preventing the need for restoration.

Our curriculum is contemporary and evidence-based " Dr. Weyant said. In their first year of study, dental students engage in a laboratory course to learn a standardized approach to diagnosing caries, with an emphasis on early decay. This course, is taught by Dr. Anchal Malik, assistant professor in the Department of Dental Public Health

The course recently was combined with the restorative dentistry course because the appropriate management of caries occurs along a continuum from primary prevention (like fluorides), secondary prevention of early lesions (like sealants) and ultimately restorations. Providing all of this within the context of caries prevention and management in a single course creates an understanding of the association of the various approaches to prevention and treatment and fosters appropriate, evidence-based care, Dr. Weyant said.

Anchal Malik
Assistant Professor
Department of Dental Public Health

Also, thanks to electronic health records, the school has the ability to track the way in which caries are diagnosed and managed for each patient. This technology can ensure that appropriate care is being provided and improve feedback to students about the success of their prevention and restorative interventions.

In the pre-clinical course, students establish a tooth library so they can see the progression of lesions and identify if there is a non-cavitated lesion, where treatments could be done to remineralize without drilling. In the preclinical laboratory course, students are taught not only to spot early lesions but also learn to apply fluoride varnish as well as silver diamine fluoride on extracted teeth, In the preclinical laboratory students are able to visualize the caries disease progression on the extracted teeth which they collect.

"We want students to understand these concepts from the beginning. We want them to understand how the entire cycle works, so by the time they get to the clinics, they are ready for it," Dr. Malik said.

When it comes to the future, Pitt Dental Medicine faculty overwhelmingly agree that a multidisciplinary approach—in terms of teaching, clinical practice and research—is imperative.

"Science and technology develop so fast and in so many ways, it is hard to say what could happen next," Dr. Sfeir says. "It's evident to us, though, that this work will become more and more interdisciplinary and will be conducted by diverse and talented teams that include instructors and clinicians, rather than by only researchers."

Because biomineralization is central to dental disciplines, not to mention overall health, collaborating on dental research efforts is imperative to bringing forth new, innovative treatments. From mineral formation at the nanoscale to genetic testing to clinical application, dental researchers must work together with experts from a variety of disciplines to harness the power of biomineralization—all to restore patients' health.

Center for Craniofacial Regeneration team

Dr. Jacqueline Burgette

As a pediatric dentist, it was common for Dr. Jacqueline Burgette to hear that children were receiving candy and soda when visiting their grandparents or family friends. These casual remarks made an impression on Dr. Burgette, driving her to investigate how parents, family members and friends influence the oral health of children.

Dr. Burgette earned her DMD from Harvard University and then a PhD in Health Policy and Management at the University of North Carolina at Chapel Hill. There, her dissertation looked at the effect of Early Head Start, a government program, on children's use of dental care.

Motivated to continue this work, Dr. Burgette joined Pitt Dental Medicine in 2017 as an assistant professor in the Departments of Dental Public Health and Pediatric Dentistry. Her work addresses oral health disparities in children through health services research—how people access care, how much it costs, as well as patient outcomes.

"It's not just about where we work and play, it's about who we know. My research seeks to understand just how powerful those relationships are."

It became obvious to Dr. Burgette that relationships matter when it comes to oral health. If a close family member tells a mom, 'It's important to brush your teeth with fluoride toothpaste,' that message could carry more weight than if the mom hears it from someone she doesn't know well. Similarly, if a mother receives advice from another mom about dental health, that could strongly influence oral health outcomes among children."

This advice-sharing and influence is especially prevalent in areas such as Northern Appalachia where there is an epidemic of poor oral health in children. Dr. Burgette is intrigued by this area and currently is pursuing a study funded by Robert Wood Johnson that will be the first to determine whether there is a link between a mother's relationships and the oral health of her child in Northern Appalachia.

"For better or worse, we are all influenced by the behaviors of those around us—that includes how we feed our children, clean their teeth and when we take them to the dentist," Dr. Burgette said. "Looking at Appalachia, I want to see how mothers' relationships affect how she cares for her child's teeth and mouth. I want to see, for example, whether children getting cavities is in part due to influences from the people these mothers know."

Dr. Burgette said her research would not be possible without Pitt's Center for Oral Health Research in Appalachia (COHRA). In particular, she thanks Dr. Mary Marazita, Dr. Robert Weyant and Dr. Daniel McNeil, as well Zelda Dahl, a staff member at COHRA, who have been essential to collecting important data from mothers in Northern Appalachia.

"It's not just about where we work and play, it's about who we know," Dr. Burgette said. "My research seeks to understand just how powerful those relationships are."

Jacqueline Burgette DMD PhD
Assistant Professor
Department of Dental Public Health
Department of Pediatric Dentistry

Dr. Giuseppe Intini

Pittsburgh has been a breath of fresh air for Dr. Giuseppe Intini, associate professor in the Department of Periodontics and Preventive Dentistry and a member of the Center for Craniofacial Regeneration (CCR).

Born in Italy, Dr. Intini's previous appointment was at the Harvard School of Dental Medicine, nestled in the bustling area of Cambridge, Massachusetts. There, he worked on stem cell research alongside a number of esteemed scholars. Here at Pitt Dental Medicine, he is able to work more frequently with Pitt colleagues from all disciplines, which he prefers.

"When you are at a big place like Harvard, the opportunities to create collaborations across departments are not always easy," Dr. Intini said. "At Pitt, people are eager and willing to collaborate, and these partnerships almost happen organically. It's a fantastic place to be."

"At Pitt, people are eager and willing to collaborate. It's a fantastic place to be."

Dr. Intini's research focuses on the biology of the skeletal and periodontal stem cells. His lab studies the molecular mechanisms that control the "stemness" of these stem cells—their contribution to tissue repair and regeneration, and their role in the development of certain bone and periodontal diseases.

Dr. Intini is particularly focused on osteosarcoma—a cancer of the bone diagnosed primarily in people under the age of 25 and one of the leading causes of death among young children.

Over the past 30 years, there has been little improvement in treatment options for this cancer. While doctors have figured out how to intercept a sarcoma, they are unsure what to do once it has metastasized. Therefore, morality rates are similar to those three decades ago.

Funding support from the National Institutes of Health (NIH) permits Dr. Intini to perform much of the necessary research to better understand this peculiar cancer. He is working under the hypothesis that cancer stem cells are involved in the development of sarcoma and, more specifically, the metastasis, which usually occurs in the lungs.

In the lab, he and his team are tracing cell signaling. By watching this cellular behavior in a cancerous micro-environment, he can explore exactly how metastasis occurs.

"If we figure this out, we can work on new therapies that would specifically target these cells and increase the survival rate of this aggressive cancer, which is a big cause of death among children," Dr. Intini said.

During his time at Pitt Dental Medicine, Dr. Intini has forged a number of connections. He is involved with the Pittsburgh Sarcoma Research group, a new group comprising cancer biologists and cancer doctors. He also is starting new work with Dr. Charles Sfeir looking at amino modulators in periodontal disease. "Dr. Sfeir is actually one of the reasons I moved here—he's been trying to get me to join Pitt for years. I'm glad to be here now," Dr. Itini said.

Dr. Intini feels at home in his new city and among his peers at the University of Pittsburgh, he is impressed by the overall nature of humanity. "It is an environment where people are happy," he said. "That's very significant to me and has played a role in my own work here."

Giuseppe Intini DDS PhD
Associate Professor
Department of Periodontics and Preventive Dentistry

Dr. Fatima Syed-Picard

Dr. Fatima Syed-Picard is a builder at heart. Her groundbreaking work in craniofacial regeneration and therapy is motivated by a desire to form bridges between biologists and engineers.

"I love watching how different people approach the same problem. I've always known how important it is working with diverse backgrounds, and that influences my research here at Pitt Dental Medicine," said Dr. Syed-Picard, an assistant professor in the School of Dental Medicine Department of Oral Biology and member of the Center for Craniofacial Regeneration (CCR).

Prior to joining Pitt Dental Medicine, Dr. Syed-Picard studied materials science at the University of Michigan, where she most often worked with engineers. She then went on to work for the National Institute of Dental and Craniofacial Research (NIDCR).

These two experiences shaped Dr. Syed-Picard's career, leading her toward a PhD in bioengineering, which she earned from Pitt in 2013. Now, she studies dental stem cells and tissue engineering at Pitt Dental Medicine

Being an engineer has proven to be instrumental to Dr. Syed-Picard's research, which focuses on regenerating tissue—such as bone, dentin-pulp complex and nerve—for therapeutic use. Her work focuses on scaffold-free tissue engineering. These 3D tissues mimic naturally formed, healthy tissue and can be used as a therapy for patients who have damaged or diseased tissues.

"It's important to have diversity in backgrounds when building teams ... the best research happens in teams."

"Scaffold-free tissue engineering gives cells the ability to self-assemble into organized, multi-tissue or organ structures, which is a huge problem right now in the field of tissue engineering," Dr. Syed-Picard said. "A big focus of mine is to uncover the mechanisms that allow cells to, on their own, produce multiple organized tissue. We hope to use these constructs not only for regenerative treatment devices but models of tissue development as well."

Dr. Syed-Picard's current research direction considers peripheral-nerve and facial nerve regeneration. Under current medical practice, facial nerve damage is repaired by end-to-end suturing or using autograft tissue where the healing process takes a long time. Even then, fully functional recovery may not be possible.

Recent studies have shown that certain neurotrophic factors can enhance regeneration if delivered to the damaged tissue. Yet, it's unclear how. In an effort to learn more, Dr. Syed-Picard produces scaffold-free cell sheets, which are layers of dental-pulp cells grown on culture dishes in the lab, which in turn produce neutrophic factors.

"We have a lot of work showing that our cell sheets are producing high levels of these neurotrophic factors. The implantation of these sheets at sites of facial nerve injury could potentially really accelerate and enhance regeneration," Dr. Syed-Picard said.

She continues working to bridge the gap between engineers and scientists, and feels strongly supported in her research efforts at Pitt. Now, thanks to the rich expertise of her peers at Pitt Dental Medicine, she can reach out farther and collaborate on a much broader scale.

"It's important to have diversity in backgrounds when building teams that are working on regenerative medicine," Dr. Syed-Picard said. "The best research happens in teams. Given Pitt Dental Medicine's strong involvement in this area, I feel I have all of the resources and collaborators I need to be successful."

Dr. Dobrawa Napierala

A background in biology is essential for understanding the mineralization process in dentistry, something Dr. Dobrawa Napierala learned early in her career.

In her native Poland, she trained as a bone biologist and worked on skeletal tissues, their development and disease. Through her work, she quickly became curious about the process of mineralization and how it is regulated at the molecular level.

Now, Dr. Napierala is an associate professor in the Department of Oral Biology at Pitt Dental Medicine with a joint appointment in the Department of Periodontics and Preventive Dentistry.

"It's an exciting time to be at Pitt ... we have some of the top experts in the field working together to understand the mineralization process."

Driven to understand mineralization as it relates to dentistry, she moved to Pittsburgh to study with the experts in the field.

"It's an exciting time to be at Pitt," Dr. Napierala says. "Here, we have some of the top experts in the field working together to understand the mineralization process. Their expertise perfectly complements my own."

Currently, Dr. Napierala is trying to understand how cells respond to phosphate ions, which is important for biomineralization. Phosphate ions together with calcium form a mineral in all hard dental tissues.

Dental tissues are inevitably affected by inappropriate phosphate levels. For example, patients with hypophosphatemia or phosphate deficiency have under mineralized teeth and periodontal disease. On the other hand, patients with hyperphosphatemia, a condition indicating high phosphate or an excess of phosphate, may have overgrown tooth roots and dental pulp stones.

Understanding how phosphate affects the physiology of cells is important in terms of understanding these dental disorders and formation of dental tissues, Dr. Napierala says. "How do cells sense phosphate? How do they know how much is available? What do they do in response to phosphate on the molecular level? My work is investigating the molecular pathways these cells use to active the mineralization process."

Dr. Napierala approaches her work from multiple angles with one clear goal in mind: improving human health. If she and other researchers at Pitt Dental Medicine can understand the molecular process behind mineralization, it could lead to a number of discoveries and treatments.

"I'm honored to work alongside researchers such as Dr. Elia Beniash, Dr. Charles Sfeir, and others, whose work is intricately intertwined with mine," she said. "Together, we really can look at this process in more detail, which could aid in a number of regeneration treatments and modalities."

Dr. Patrick Donnelly

True discovery will be made between scientific disciplines—not in an individual discipline. This thinking drives the work of Dr. Patrick Donnelly, a current student at Pitt Dental Medicine, whose research lies at the intersection of chemistry and biology.

Dr. Donnelly has spent his academic life engaged in chemistry research. He earned his master's degree and PhD from Princeton University, where he focused on the chemistry of surfaces and interfaces. After graduation, he spent three years at Hospital for Special Surgery (HSS) as a National Institutes of Health (NIH) T32 postdoctoral fellow, where he studied articular cartilage—the white tissue coating bones at joints.

"Pitt Dental Medicine has research and clinical faculty that are very interested and excited to work on ... true cutting-edge research,"

His work at Princeton and HSS led quite naturally to an interest in dental regeneration, which also relates to surface chemistry. As a research fellow at the Center for Craniofacial Regeneration (CCR), Dr. Donnelly is working under the advisement of Dr. Juan M. Taboas. Together, they are studying the synthesis and characterization of gelation hydrogels, unique materials that can be used for dental pulp regeneration. These gelatinous sponges can be used as scaffolds to mimic the mouth's healthy native tissues.

Dr. Donnelly also is interested in zirconia, a ceramic material being used as a fixed prosthesis and implant. His current work investigates the low-temperate phase transitions in zirconia that may ultimately compromise device performance. This material, once better understood, could eventually be a game changer in the dental field.

No matter the project, Dr. Donnelly approaches his work with a multidisciplinary lens, and has since the beginning of his research career. He has long known that to be successful, he must work with experts across fields to tackle hard problems.

"It is not always easy to leave your field and your comfort zone to address these problems." Dr. Donnelly said. But thanks to excitement and numerous engagement opportunities at Pitt, he's been able to do this fairly easily.

"Pitt Dental Medicine has research and clinical faculty that are very interested and excited to work on multidisciplinary projects, and this has enabled me to work on true cutting-edge research," Dr. Donnelly said. "It's advanced my research efforts while also broadening my scope. It's an exciting place to be for this type of work."

Patrick E. Donnelly PhD
DMD Student Class of 2021

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, directed by Professor Mary L. Marazita and co-directed by Associate Professor Seth Weinberg. Since 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, on the Monongahela River near the Hot Metal Bridge, close to the University of Pittsburgh Oakland campus.

Mary L **Marazita** PhD

Director, CCDG

Professor of Oral Biology, Human Genetics, and Clinical and Translational Sciences

Dr. Marazita's involvement in orofacial cleft research traces its roots back to her time as a postdoctoral student in the 1980s

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. Weinberg, plus an extensive network of collaborators within the University of Pittsburgh and at many other universities world-wide.

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 UCLA and the Medical College of Virginia, Dr. Marazita joined the University of Pittsburgh in 1993 as Director of the Cleft Palate-Craniofacial Center 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. She also is participating in Dr. Weinberg's studies of normal facial variation.

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 have overall a higher mortality rate. Ever 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), part of the National Institutes of Health (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 new grants received from the Gabriella Miller Kids First Pediatric Research Initiative (GMKF) from the Office of the NIH Director (https://commonfund.nih.gov/kidsfirst/overview). In the past year, there have been 16 new publications regarding orofacial cleft research results from Dr. Marazita, Dr. Weinberg, and collaborators.

"All of our faces are unique and our facial features show a great deal of variation. Evidence points to the fact that much of this observable variation can be explained by genetic differences among individuals."
—Dr. Seth Weinberg

Seth **Weinberg** PhD

Co-director, CCDG

Associate Professor of Oral Biology,

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 with receipt of the first grant from the NIDCR, in collaboration with 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 Center for Oral Health Research in Appalachia (COHRA) projects include multidisciplinary analyses of (i) a cohort of households in rural Appalachia; (ii) a cohort of Caucasian mother-child pairs recruited during pregnancy and followed until the child reaches at least age 6; and (iii) a new cohort of African American mother-child pairs recruited during pregnancy.

These studies in Appalachia have led to 5 publications in the last year. Notably, data from the study has been part of a global consortium to analyze dental genetics in a very large combined cohort with results expected to be published in the near future.

Discovering the Genetic Basis for Facial Variation

CCDG studies on the genetic basis of normal-range variation in human facial features were spurred initially by the CCDG phenotypic studies of orofacial clefting and are led by CCDG Co-Director and Department of Oral Biology Associate Professor, Seth Weinberg, PhD.

"All of our faces are unique and our facial features show a great deal of variation. Evidence points to the fact that much of this observable variation

can be explained by genetic differences among individuals," said Dr. Weinberg. "Our goal is to identify which parts of the genome are associated with specific facial features." Studies like this can help researchers gain a better understanding of how particular genes and pathways influence facial development, improve knowledge of how genetic variation relates to the features in certain birth defects and syndromes, and eventually allow for creation of predictive models about how the face grows.

Not long after joining the Pitt 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 FaceBase, Dr. 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. 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 student of complex craniofacial traits.

Learn more about the 3D Facial Norms Project by visiting **facebase.org/facial_norms**.

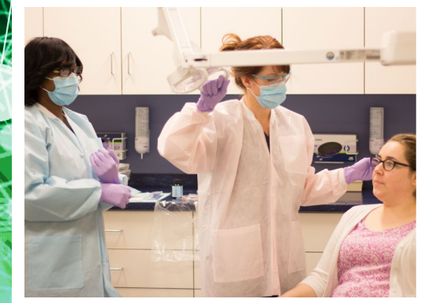
Multiple high-profile publications have arisen from Dr. Weinberg's studies in recent years, including two particularly important papers on this topic.

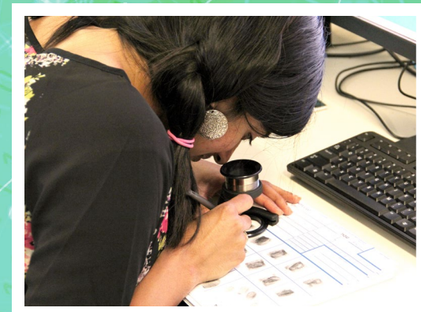
In late 2017, in a paper published in the *American Journal of Human Genetics*, exploded the myth that earlobe attachment is not a simple Mendelian trait, as so many of us learned in grade school. On the contrary, almost 50 regions in the genome appear to be associated with this trait. The study also showed that many of the implicated genes are expressed in the developing human and mouse ear. This project, 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.

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 important 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."

More recently, over the past year, 5 additional publications on facial variation by Dr. Weinberg and collaborators have been published, with multiple others in preparation. These are made possible by a recent $1.7 million NIH grant awarded to Dr. Weinberg and collaborator Dr. John Shaffer (secondary appointment in the Department of Oral Biology) to continue this line of investigation.





Keynote Speaker

Franklin Tay BDSc (Hons) PhD

Chair and Professor, Department of Endodontics
The Dental College of Georgia, Augusta University

Dr. Franklin Tay received his BDSc with first class honors from the University of Queensland School of Dentistry in Australia in 1981, his PhD from the University of Hong Kong, China, in 1997 and completed his endodontic residency at the Medical College of Georgia in 2007. He is a Diplomate of the American Board of Endodontics. Currently, he is professor and chair of the Department of Endodontics, College of Dental Medicine, Georgia Regents University.

Dr. Tay serves as associate editor for the *Journal of Endodontics* and *Journal of Dentistry*. His research interests include biomineralization of collagen scaffolds with apatite and/or silica; remineralization of resin-dentin bonds; antimicrobial sol-gel chemistry; and mesoporous silica and endodontic materials. He is a fellow of the Academy of Dental Materials and has published more than 500 papers in peer-reviewed journals.

BIOMIMETIC MINERALIZATION OF COLLAGEN

Remineralization of demineralized dentin is important for improving dentin bonding stability and controlling primary and secondary caries. Nevertheless, a conventional dentin remineralization strategy is not suitable for remineralizing completely demineralized dentin within hybrid layers created by etch-and-rinse and moderately aggressive self-etch adhesive systems, or the superficial part of a caries-affected dentin lesion left behind after minimally invasive caries removal.

Biomimetic remineralization represents a different approach to this problem by attempting to backfill the demineralized dentin collagen with liquid-like amorphous calcium phosphate nano precursor particles that are stabilized by biomimetic analogs of noncollagenous proteins.

In this presentation, the changing concepts in calcium phosphate mineralization of fibrillar collagen will be reviewed including the recently discovered, non-classical particle-based crystallization concept; formation of polymer-induced liquid- precursors (PILP); experimental collagen models for mineralization; and the need for using phosphate-containing biomimetic analogs for biomimetic mineralization of collagen. The problems and progress associated with the translation of a scientifically-sound concept into a clinically-applicable approach will be discussed.

Keynote Speaker

Steven Bloembergen PhD
Chairman and CEO
GreenMark Biomedical, Inc.

Dr. Steven Bloembergen founded GreenMark Biomedical in Michigan in 2016 to deliver health-based benefits to society through biobased targeting technologies. GreenMark's mission is to "enable dentists to preserve teeth through early diagnosis and treatment."

Dr. Bloembergen has 30 years of leadership experience in the development and commercialization of biomaterials. He started a company called EcoSynthetix (ECO) in Lansing, Michigan, in 1996, now a global corporation. In January 2011 ECO opened its state-of-the-art Center of Innovation facility in Burlington, Ontario, where it pursues the development of biobased products for industrial applications. He and his team helped prove out the technology with pilot lines and production sites in the United States and Europe, building a manufacturing capacity for starch nanoparticles in excess of 200 million pounds per year. The company held its IPO in August 2011 (TSX: ECO) and was Canada's largest IPO in the clean technology (cleantech) sector. In 2012, Steven received the Ernst and Young 2012 Entrepreneur of the Year Award. He developed a broad global IP portfolio and established a network of university collaborators. These collaborations, using ECO's starch nanoparticles for dental & medical applications, resulted in the foundational technology for GreenMark.

Dr. Bloembergen is the inventor of more than 25 patent families related to biomaterials. He received his PhD in polymer science and engineering from the University of Waterloo, Ontario. His passions include entrepreneurship and downhill skiing.

TARGETED BIOBASED NANOMATERIALS FOR MINIMALLY INVASIVE HEALTHCARE APPLICATIONS

Problem

Dental caries is the most prevalent chronic disease worldwide, and nearly everyone will develop caries at some point in their life.[1-4] At any given time 42% of children and 25% of adults have untreated caries,[1,3] leading to complications ranging from pain, infection, poor quality of life and in rare cases, death.[5-10] Globally it is estimated that over $200 Billion is spent annually on the management of this disease and its complications.[11] Surgical treatment results in an irreversible restorative cycle leading to multiple replacement restorations, crowns and eventually tooth loss or dental implants as patients age.[12-14] Carious lesions initially form when bacteria in the dental biofilm ferment sugars and produce organic acids, which demineralize enamel. As minerals leach from enamel rods, the area becomes more porous and weakens. The early lesion is comprised of a surface layer (surface zone) which appears relatively unaffected by the carious attack compared to the subsurface (lesion body). Areas of subsurface porosity present clinically as a milky white opacity known as a "white spot lesion" and identify early stage caries to the dental professional. If the process is not reversed, tiny open microchannels in the enamel surface allow acid to continue entering the subsurface. The lesion thus becomes more and more porous, until it eventually cavitates, requiring surgical restoration. However, the caries process is dynamic and it is now understood that early stage caries is reversible with better hygiene and remineralization agents such as high fluoride treatments or toothpastes.[15] It is also known that some caries become inactive or "arrested" and do not require any treatment,[16,17] because the porosity particularly on the surface has been reduced by mineral and/or protein deposition. A better understanding of the caries process has led to a paradigm shift in caries management which emphasizes enamel preservation, leading to better oral health outcomes.[16-22] The main problem is that current diagnostic methods are unsatisfactory. Diagnostic tools for early detection of caries on vulnerable tooth surfaces are limited,[23-26] as is the ability to monitor the positive impact from remineralization treatments.[27,28] Current diagnostics include the visual exam and X-Rays which have

limited sensitivity. Dentists typically identify white spot lesions when they are at least 0.5 mm in size. Smaller (early) carious lesions are generally missed. X-Ray images of teeth delineate advanced cavities but lack the resolution to identify early forming lesions.16,27 Tactile probing with a dental explorer is widely used but this can cause cavitation.[29-33] Several emerging techniques for caries detection have been developed to try to address these drawbacks,[8,14,24] however, these methods require additional equipment, show little benefit over visual & tactile detection, and incur greater cost to dentist and patient.[23,24,34-36] There is to date no reliable method to determine caries "activity" at the point of care, in one visit.[34-38] This is a critical factor in clinical decision making and remains the holy grail of cariology. Dentists currently rely on subjective assessments of the lesion to determine if it is active,[35,38] often resorting to placing lesions on a "watch" with no means to determine success of preventive approaches or conservative treatments,[2] besides waiting to see if a lesion advances and eventually cavitates, leading to surgical intervention. Alternatively, dentists inappropriately proceed with invasive treatment of inactive/arrested lesions.

Solution

Stemming from an invention at University of Michigan (UofM), GreenMark Biomedical is developing LumiCare™. This new diagnostic is a quick aqueous oral rinse containing proprietary functionalized nanoparticles made from food-grade starch.[39-46] LumiCare™ is to be administered following dental cleaning, as part of the routine dental exam. The product selectively associates with the subsurface of active carious lesions which illuminate using a standard curing lamp found in every dental practice, augmenting the dentist's visual exam. By earlier detection and identifying "activity", the test will prevent unnecessary treatment of inactive/arrested lesions and allow greater use of noninvasive treatments of active lesions such as plaque removal, fluoride treatments and/or toothpastes. Success of these interventions can be monitored at subsequent dental visits by further application of LumiCare™, to result in improved oral health outcomes. GreenMark's technology platform also has other dental and medical applications currently under development. The development of BioFilling™, for example, is being supported by the NIH/NIDCR funded Michigan-Pittsburgh-Wyss Regenerative Medicine (MPWRM) Resource Center. This involves calcium/phosphate/fluoride loaded starch nanoparticles and using them to target the interior of early pre-cavities to non-invasively remineralize and repair them, designed to enable pain-free dentistry and help eliminate patient fear, a common barrier to dental care.

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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, orofacial clefting, and normal facial variation, with an emphasis on genomic and phenotypic analyses.

Led by Director Dr. Mary L. Marazita and co-Director Dr. Seth M. Weinberg, the CCDG currently comprises 3 faculty (plus 10 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 $6 million annually.

CCDG Faculty

Mary L. Marazita, BS, PhD, FACMG
Professor
CCDG Director

Katherine Neiswanger, BA, MA, 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, post-docs, 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

Bernard J Costello, DMD, MD
Professor and Dean

Jin Gao, PhD
Research Assistant Professor

Xuehui Geng, MD
Research Scientist

T Jayaraman, MS, PhD
Assistant Professor

Kai Liu, MD, PhD
Research Associate

Henry C. Margolis, PhD
Clinical Professor

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

Alexandre 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 of 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 Weyant, MS, DMD, DrPH
Professor
Chair
Associate Dean for Dental Public Health and Community Outreach

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

Nyla Balakrishnan, BDS, MPH, MS
Clinical Assistant Professor

Jacqueline Burgette, DMD, PhD
Assistant Professor

Zsuzsa Horvath, PhD
Assistant Professor

Anchal Malik, BDS, MHA
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

Dental Registry and DNA Repository

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 6,300 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
School of Dental Medicine

GRADUATE OPPORTUNITIES

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 videoscopes, and three video laryngoscopes.

- 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 (WISER) Center, where students are assessed as they manage various office emergencies in real time using high-fidelity human simulators.
- Department of Dental Anesthesia 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 their 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.

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. Several departmental faculty members are supported by a large 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. Dr. Jacqueline Burgette is the recipient of the Harold Amos Medical Faculty Development Program that will support her study of the role of mother's social networks on their children's oral health. Dr. Deborah Polk received NIDCR funding to develop implementation strategies for dental sealants in collaboration with colleagues at Kaiser Permanente. The department maintains active research collaborations with the University of Pittsburgh Cancer Institute (UPCI), Magee-Women's Hospital, the Clinical and Translational Science Institute (CTSI), and numerous other research universities in the United States and abroad.

The teaching mission of the department features a variety of well subscribed certificate and masters programs. Dr. Zsuzsa Horvath directs the Academic Career Track Area of Concentration, which offers a certificate program in academic dentistry. Dr. Richard Rubin directs the recently developed certificate program in dental public health. This new program dovetails with our ongoing dual degree (DMD, MMPH) program with the Graduate School of Public Health. Dr. Robert Weyant is co-director of the HRSA funded residency program in pediatric dentistry and dental public health in collaboration with Dr. Studen-Pavlovich in Pediatric Dentistry. Graduates of this program receive both a residency certificate in pediatric dentistry and an MMPH degree. Dr. Anchal Malik is offering for the first time a new course in contemporary caries diagnosis and staging as part the overall caries prevention and management curriculum.

Diagnostic Sciences

The Department of Diagnostic Sciences in the School of Dental Medicine is responsible for the areas of Oral and Maxillofacial Radiology, Oral and Maxillofacial Pathology, Oral Medicine, and Dental Emergency Medicine. The department has faculty that have achieved diplomate status ("boarded") in their respective specialties, 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 offers a three-year residency program in Oral and Maxillofacial Pathology.

Services provided by the department to the local dental community include detailed interpretation of radiographic images, including CBCT and panoramic radiographs, and interpretation of surgical pathology specimens by the Oral Pathology Biopsy Service.

The Department is engaged in research at many levels. The department hosts summer research scholars and participates in residents' research projects. In addition, faculty have their own research endeavors. Recent projects include comparative studies of CBCT versus panoramic radiographs assessing temporomandibular joint changes and inferior alveolar nerve position; comparative radiographic features of ossifying fibromas and other benign fibro-osseous lesions; data-mining of the axiUm electronic record to assess treatment disparities of disadvantaged patients; quality assessment outcomes of consultation recommendations; investigation of the molecular pathogenesis of odontogenic tumors; cancer chemoprevention using lyophilized fruits; immunohistochemical features of salivary gland neoplasms; demographics and outcomes of the biopsy service; assessment of metastatic tumors to the gnathic region; and demographics and outcomes of the oral medicine clinical practice.

Endodontics

Certificate in Endodontics with Optional MDS Degree

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.
- Safety and 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.
- Applicants must have completed a GPR program or have private practice experience.

Oral Biology

MS or PhD Degree

The graduate program in oral biology provides comprehensive and interdisciplinary translational and basic science training in dental, oral and craniofacial research. Our students are involved in the development of novel approaches to craniofacial regeneration and diagnostic tools for oral and craniofacial diseases and disorders with the aim of improving health and well-being. The development of these therapies, biomaterials and diagnostic tools is guided by fundamental research in genetics and molecular pathology, as well as fundamental biological phenomena related to the development, structure and function of the craniofacial region.

Promising DMD dental students and residents are encouraged to enter the PhD or MS programs in oral biology and pursue their DMD and graduate degrees simultaneously. Dental students in the graduate program will follow all requirements for the PhD or MS program, as well as complete research requirements toward an MS or PhD degree.

Research Focus

The School of Dental Medicine ranks number four in National Institute of Dental and Craniofacial Research (NIDCR) funding among the 58 U.S. dental schools. Our dedicated faculty provides a stimulating and collegial environment to prepare motivated and qualified students for careers as clinicians and scientists in academia, industry and government.

The focus of the program is on oral health and biomedical research and teaching. The program's scope encompasses studies of fundamental biological phenomena related to the development, structure and function of the craniofacial region, and the development of new therapies, biomaterials and diagnostic tools for the treatment of diseases and disorders in the craniofacial area. Currently, faculty in the Department of Oral Biology are focused on two areas of research concentration (ARCOs): craniofacial regeneration and craniofacial and dental genetics. These form the bases of graduate training in this program.

Meet Our Students

Meer 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 involve sautografts; 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 genes affecting susceptibility to dental caries in a large multiethnic population, originally recruited for studies of orofacial clefts 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 orofacial clefts. Ms. 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 decellurazed 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 Bezamat 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. Bezamat will test how oral health outcomes and overall health comorbidities of individuals who 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 orofacial 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 Lucca, 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 (TMD). He wants to know whether malocclusion can lead to orofacial 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 Smethurst 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. Smethurst presented her research at the Pitt Dental Medicine Seventeenth Annual Research Symposium in 2017.

Mostafa Shehabeldin's research focuses on developing sustained release polymer (PLGA) microspheres for treating periodontal disease. When locally delivered in periodontal tissues, these polymer microspheres will release encapsulated anti-inflammatory 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. Shehabeldin 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.

Yingci 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.

Oral and Maxillofacial Surgery

- 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. Three residents are accepted each year as well as one pediatric craniomaxillofacial fellow.

Research Focus

- Regenerative medicine of craniomaxillofacial defects.
- TMJ reconstruction with tissue engineering.
- Stem cell-mediated regeneration of lost tissues.
- Sleep apnea outcomes.
- Virtual surgical planning outcomes.
- Resorbable metal technologies.
- Cleft 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 first-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.
- Fellows must be graduates of a CODA-accredited OMS residency program.
- Application deadline is September 15 of each year.

Orthodontics and Dentofacial Orthopedics

Certificate in Orthodontics with Optional MDS Degree

Graduates will be eligible to take the examination for specialty certification in orthodontics offered by the American Board of Orthodontics.

Research Focus

- Craniofacial morphology and function in different populations
- Efficiency and efficacy of treatment modalities
- Craniofacial molecular and cellular control mechanisms
- Impact of biomaterials on delivering orthodontic mechanics

Clinical Training

- Diagnosis, prevention, and treatment/management of abnormal congenital or developmental relationships of the dentofacial anatomy, from infancy to adulthood, in diverse populations

Criteria

- Applicants must hold a DMD or its equivalent.
- Application deadline is September 15, 2019.

Pediatric Dentistry

Certificate in Pediatric Dentistry with Optional MDS Degree

Graduates are required to take the qualifying examination of the American Board of Pediatric Dentistry at the end of the second year of training.

Research Focus

- Prenatal counseling for oral health
- Oral health promotion for disadvantaged children
- Infant oral health
- Early childhood caries
- Obesity and its relationship to dental development and physical growth
- Etiology, microbiology, prevention, and control of dental caries
- Dental trauma and its prevention
- Adolescent dentistry
- Behavior guidance and management for the pediatric dental patient

Clinical Training

- Advanced diagnostic and clinical training necessary to provide specialty care to infants, children, adolescents, and individuals with special needs.
- Clinical rotations at Children's Hospital of Pittsburgh of UPMC in anesthesiology, pediatric medicine, and hospital grand rounds.
- Teaching component in the predoctoral, preclinical, clinical, and didactic courses.

Criteria

- Applicants must be graduates of a U.S. or Canadian dental school.
- Application deadline is September 15, 2019.

Periodontics and Preventive Dentistry

Certificate in Periodontics with Optional MDS Degree

The Periodontics Residency at University of Pittsburgh School of Dental Medicine is an active, clinical and research-focused program that prepares its residents to be both excellent clinicians and involved in research. Clinical training is paired with hands-on research experience, innovative collaborations within the dental school and throughout the University are among the unique offerings this program features. This program is recognized by the American Dental Association and the Academy of Periodontology. Graduates will be eligible to take the board examination of the American Academy of Periodontology.

Research Focus

- Osteoimmunology
- Developing periodontal therapies by modulating the immune system
- 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 diagnostics and therapies and is expected
- Application deadline is August 1 of each year.

Prosthodontics

Certificate in Prosthodontics with Optional MDS Degree

Senior Residents must challenge the written portion of the examination for certification in prosthodontics offered by the American Board of Prosthodontics. 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), ACP PA Chapter annual meeting.

Research Focus

- Dental materials
- Industry collaborations to assess and improve restorative treatments
- Implant supported restorations
- Digital Dentistry fabricated restorations via CAD-CAM and 3-D printing

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 TMD conditions
- 20-25% of the residency is spent in the Implant Center

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/html

RESEARCH INTERESTS

Alejandro Almarza

Dr. Almarza is an assistant professor in the School of Dental Medicine Department of Oral Biology with a secondary appointment in the Department of Bioengineering and the University of Pittsburgh McGowan Institute for Regenerative Medicine. His research interests are temporomandibular joint cartilage and bone regeneration and biomechanics; development of novel bioreactors to further enhance healing; identifying appropriate stem cell sources for tissue engineering approaches such as bone marrow, muscle and fat; genetic manipulation of cells seeded on scaffolds to promote regeneration; and quantitative assessment of joint movement and kinematics.

Nyla Balakrishnan

Dr. Balakrishnan has varied research interests that include oral health literacy, geriatric dentistry, medical-dental integration, oral epidemiology, community outreach programs and the oral health workforce.

Richard E. Bauer

Dr. Bauer's research interests focus on tissue regeneration for oral and maxillofacial surgical applications. Dr. Bauer has been involved in research related to regenerative medicine for hard and soft tissue reconstruction in the oral cavity. Recently, he received funding from the Osteo Science Foundation to conduct a clinical trial to assess the efficacy of a volume-stable collagen matrix for intraoral soft tissue reconstruction and augmentation.

Dr. Bauer also has been active in applications for computer assisted planning and surgical execution in reconstructive jaw surgery, sleep apnea and dental implants. He has worked on projects related to volumetric airway analysis and predictive outcomes for maxillomandibular advancement for the management of sleep apnea. He also has been working on projects related to dynamic navigation for intraoral and facial surgery.

Elia Beniash

Dr. Beniash's primary research interest is in the area of biomineralization and bioinspired materials design. He is trying to understand basic mechanisms of mineralized tissue formation and more specifically how protein assemblies control mineral formation and organization at the nanoscale. He applies this knowledge to the design of bioinspired hierarchical nanocomposites for biomedical and other technological applications.

Elizabeth A. Bilodeau

Dr. Bilodeau's research interests include the clinicopathologic, immunohistochemical and molecular characterization of odontogenic tumors. Dr. Bilodeau serves on the editorial board of the journal, Head and Neck Pathology, and is a reviewer for several journals including The Journal of Maxillofacial Surgery and Oral Surgery Oral Medicine Oral Pathology Oral Radiology. She has authored more than 30 peer-reviewed articles.

Andrew Brown

Dr. Brown's broad research interests are in bioengineering, medical device development, translational research and academic commercial translation. His specific research focus areas revolve around bone regeneration, tissue engineering and metallic magnesium for biomedical applications. In addition to his research work as a clinical assistant professor in the Department of Periodontics at the University of Pittsburgh, he is Assistant Director for Commercial Translation Programs at sciVelo, a translational research acceleration program at the University of Pittsburgh.

Jacqueline M. Burgette

Dr. Burgette researches oral health disparities in children using health services research. Specifically, Dr. Burgette is conducting a study on the impact of mothers' social networks on children's oral health utilization, practices and dental caries experience. She is also 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.

John Burnheimer

Dr. Burnheimer's current research focuses on identifying potential contributors to disparities in orthodontic health the Appalachian region of Southwestern Pennsylvania.

William L. Chung

Dr. Chung is a Professor in Oral & Maxillofacial Surgery at the School of Dental Medicine. He has a secondary appointment in the Department of Surgery at the University of Pittsburgh McGowan Institute for Regenerative Medicine. Dr. Chung is the co-investigator of a National Institutes of Health-funded grant, utilizing tissue engineering to help create a replacement meniscus for the temporomandibular joint. This project's next goal is to proceed to a first in-human trial of the investigative device at the University of Pittsburgh Medical Center (UPMC). Dr. Chung also is involved in creating and implementing a pilot study for the American Association of Oral & Maxillofacial Surgeons that uses the art and science of simulation to recognize and treat airway emergencies in a more timely, standardized fashion.

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 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.

John Ference

Dr. Ference's primary research interest is in dental applications of 3-D printing technology.

Joseph A. Giovannitti

Dr. Giovannitti's current research focuses on the implementation of machine learning and artificial intelligence in risk analysis of patients undergoing anesthesia.

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 sociodemographic 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.

A current study is reviewing the concept of antibiotic stewardship and how it can be applied to patients who require premedication with antibiotics prior to dental care.

Zsuzsa Horvath

Dr. Horvath's 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 reflective 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. Horvath 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. Horvath'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.

Giuseppe Intini

Dr. Intini's research interests include both basic and clinical and translational science topics. His basic science research focuses on skeletal stem cells and on bone cancer stem cells. Genetic strategies and in vivo imaging are utilized to describe the location and function of these cells and the molecular mechanisms that control their "stemness" in health and disease. For instance, the laboratory has identified the calvarial suture as the niche of osteoprogenitor cells expressing Prx1, a transcription factor highly expressed during embryonic development. Current research aims at taking advantage of the existence of these cells to develop novel strategies to intercepts/prevent craniosynostosis defects or to foster craniofacial tissue regeneration. Additionally, a federally funded project (NIH/NCI) focuses on the role of cancer stem cells in the development, maintenance, and metastasis of osteosarcoma. The final goal of this project is to identify novel strategies to prevent metastasis, the ultimate cause of death in children with osteosarcoma. His clinical and translational research focuses on the beneficial effects that the use of platelet concentrates (i.e. Platelet-Rich Plasma) may have in regenerative surgical procedures in humans. The laboratory has developed a novel centrifuge-free method to prepare Platelet-Rich Plasma (PRP) and current research aims at testing the regenerative potentials of the centrifuge-free prepared PRP. Additionally, in collaboration with NASA, other investigations focus on the biological effects of certain biomaterials and microgravity on mice skeletal stem cells during life on the International Space Station.

Thomas C. 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 actively involved in teaching the pre-doctoral DDS students and is the director of didactic and preclinical laboratory courses in Dental Anatomy and Morphology and the co-director of Cariology and Caries Management courses. Additionally, she frequently collaborates as a participating faculty in other courses across SDM and is involved in co-coordinating the Cariology and Caries Management curriculum. Dr. Malik is leading the efforts across the SDM in training and calibrating students and faculty in an evidence based caries detection, and assessment system using the International Caries Classification and Management System (ICCMS) that builds on the International Caries Detection and Assessment System (ICDAS).

Her research and teaching interests vary broadly from dental caries and its management, and evidence based dentistry to educational research, teaching and learning, curriculum and professional development and interprofessional education. Additionally, 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 families ascertained 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, microbiological 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 Precisian Medicine Research Program (All of Us, https://allofus.nih.gov/) and other national and international research initiatives.

Henry C. Margolis

Dr. Margolis' research interests center on fundamental aspects of biomineralization, focusing on protein-mediated mineralization and the mechanism of dental enamel formation.

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 is Professor and Chair of the Department of Pediatric Dentistry. Her 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.

Paul A. Moore

Dr. Moore's research interests continue through investigating effective dental therapeutics and safe anesthesia. 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, 300 publications, 250 national and international presentations 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.

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 incudes 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.

Mark W. Ochs

Dr. Ochs' research interests focus on virtual surgical planning and bone regeneration and grafting in the maxillofacial region.

Jean 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 HealthPartners 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 Prasad

Dr. Prasad's research interests vary broadly from the clinical, radiologic, and histologic profile 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 and the validity of student evaluation of teaching in dental school programs.

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 obturation of the root canal system.

Richard 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 Macy 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 Sfeir

Dr. Charles Sfeir is the Associate Dean for Research, Director of the Center for Craniofacial Regeneration and Chair of the Department of Periodontics and Preventive Dentistry. Dr. Sfeir 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. Sfeir's research focus is:

1. bone and dentin tissue engineering, utilizing biomaterials and cellular strategies to regenerate mineralized tissues:
    a. biomimetic scaffolds development for bone/dentin tissue engineering using biomineralization principles.
    b. biomaterials development such as calcium phosphates or polymeric materials to regenerate bone and dentin
    c. engineering cellular therapies for bone and dentin regeneration. Strategies involve scaffoldless systems as well as stem cells in combination with biomaterials.
    d. identifying the signaling pathways involved in stem cell differentiation to bone cells.
2. biomineralization, post-translational modifications of non-collagenous proteins in bone and dentin
    a. role of protein kinases in bone and dentin formation
    b. role of phosphorylation in biomineralization
3. modulation of the immune system to develop therapies for periodontal disease,
    a. strategies to modulate the immune system to develop therapies for periodontal disease. These strategies involve local peptide or molecular agent delivery to attract T-regulatory cells or a subset of macrophages to treat periodontal disease.
4. biodegradable metals, developing load bearing bone fixation devices
    a. resorbable 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.
5. pulp tissue regeneration, develop strategies to achieve better endodontic therapies using biomaterials versus cellular approaches
6. pre-clinical testing devices for FDA approval. Our laboratory operates in a GLP-like environment. Standard Operating Procedures (SOPs) are developed for every experiment carried out in the laboratory. We have also implemented quality control procedures.

Nilesh H. Shah

Dr. Shah's research interests include latent class modeling, longitudinal data analysis, survival analysis, and predictive modeling.

Deborah Studen-Pavlovich

Dr. Studen-Pavlovich is professor and graduate program director in the Department of Pediatric Dentistry. Dr. Studen-Pavlovich's research focuses on behavior management of the child and adolescent, adolescent oral health, and obesity as it relates to the pediatric dental health and provision of care. She has mentored projects such as parental attitudes toward pediatric dentists discussing childhood obesity and parental perception of behavior guidance techniques utilized in pediatric dentistry. She serves as a reviewer for the Journal of Dentistry for Children and Pediatric Dentistry.

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 data-mining 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 N. 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 predominately 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 multi-tissue structures. Dr. Syed-Picard uses a number of engineering tools to study these constructs including as 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 Taboas

Dr. Taboas's research interests include tissue engineering of multiphasic skeletal and craniofacial tissues; microtissue fabrication with photo-patterning, biomaterial scaffolds, and microfluidic bioreactors; and real-time microscopy-based analysis of cell-material interactions.

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 Fourier Transform Infrared and Raman spectroscopies imaging coupled with microcomputed tomography and histology. His research also has focused on the use of microcomputed tomography for analysis of bones and teeth morphometry and densitometry, as well as anatomically- 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 for 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; 2) the impact of overall 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; epigenetic influences on cleft lip and palate; 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.

Suvendra Vijayan

Dr. Vijayan's research interests focus on dental and maxillofacial applications of cone beam computed tomography (CBCT) and 3-D printing.

Christine R. Wankiiri-Hale

Dr. Wankiiri-Hale's research interests are based in educational research related to student success in dental school, academic career paths in dental medicine, and enhancing diversity in dental schools. She utilizes surveys and program assessments in order to gather data to inform changes to programs that attract and retain prospective and current dental students. Dr. Wankiiri-Hale currently serves as associate dean in the Office of Student Affairs, and is a member of several professional organizations, including the American Dental Association, American Dental Education Association, Pennsylvania Dental Association and National Dental Association, and she has presented nationally on her research interests.

Seth M. Weinberg

The goal of Dr. Weinberg's research program is to leverage advanced 3-D imaging, morphometrics, and genomics tools to better understand the biological determinants of quantitative normal-range craniofacial traits (e.g. the size and shape of facial features) 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 Zaky

Dr. Zaky's research interest focuses on: 1) Osteoid-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 pulp 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.

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Books & Book Chapters

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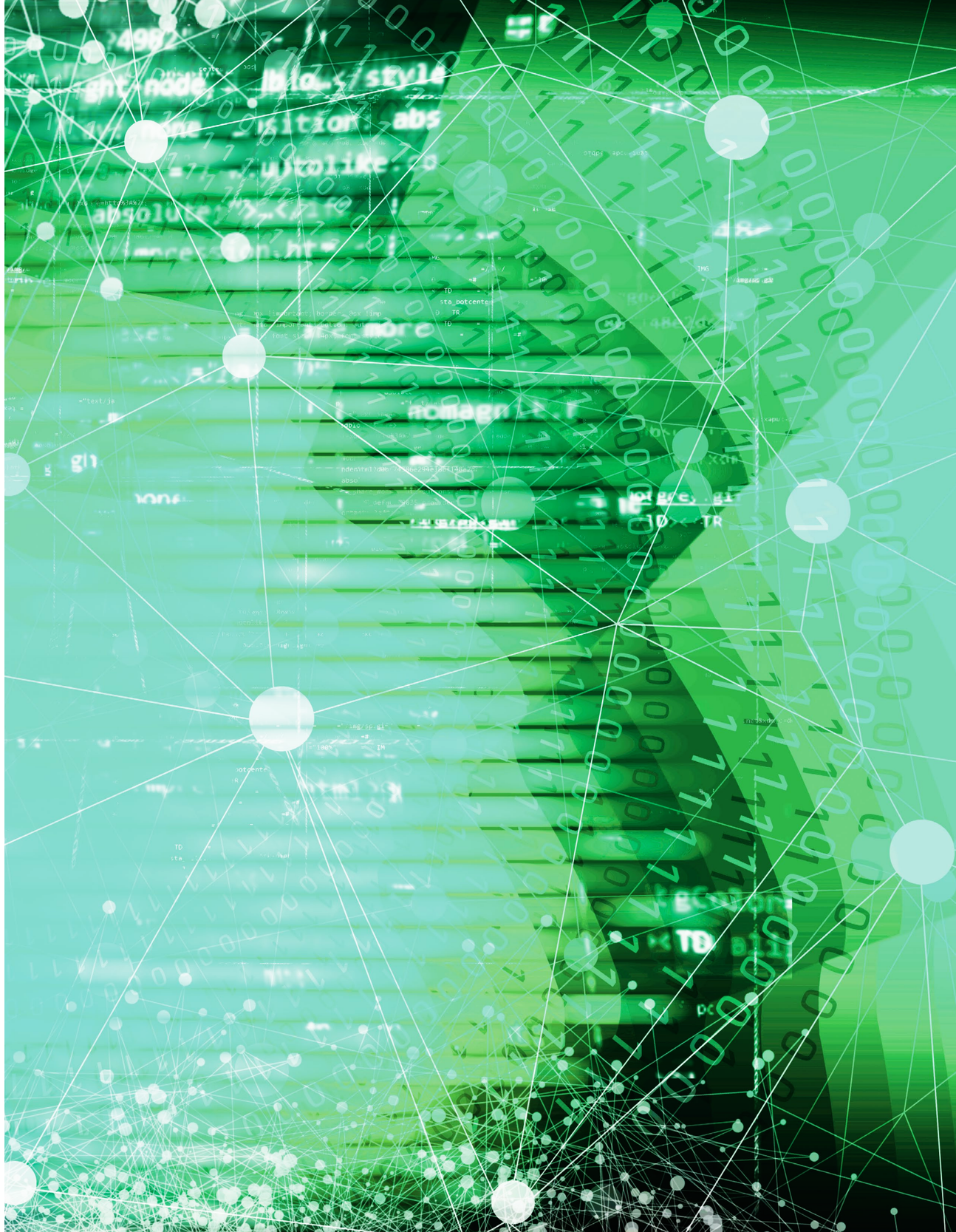

PRESENTATIONS

104th Annual American Academy of Periodontology (AAP) Annual Meeting
Vancouver, BC, Canada
October 27-30, 2018

10th Biometal Symposium on Biodegradable Metals for Biomedical Application
Oxford, UK
August 26-31, 2018

ADEA Fall Meeting
Toronto, Canada
October 24-26, 2018

ADEA Sections on Business and Financial Administration and Clinic Administration (ADEA BFACA) Meeting
Pittsburgh, Pa.
October 11, 2018

American Academy of Oral Medicine (AAOM) Annual Meeting
San Antonio, Tex.
April 10-14, 2018

Eastern Society of Teachers of Oral Pathology (ESTOP) Annual
Savannah, Ga.
December 7-9, 2018

AcademyHealth Annual Research Meeting
Seattle, Wash.
June 24-26, 2018

ADEA Assessment Conference
Washington, D.C.
February 6-8, 2019

American Dental Education Association (ADEA) Annual Session and Exhibition
Chicago, Ill.
March 15-18, 2019

41st Annual Meeting of the Society for Craniofacial Genetics and Developmental Biology
La Jolla, Calif.
October 16, 2018

48th Annual Session of the American College of Prosthodontics
Baltimore, Md.
October 31-November 1, 2018

68th Annual Meeting of the American Society of Human Genetics
San Diego, Calif.
October 18-22, 2018

96th General Session of the International Association for Dental Research
London, England
July 25-28, 2018

Academy of Osseo Integration Annual Meeting
Washington, D.C.
March 14-16, 2018

American Academy of Cariology (AAC) Annual Conference and Workshop
Chicago, Ill.
March 15, 2019

American Academy of Oral and Maxillofacial Pathology (AAOMP) 2018 Annual Meeting
Vancouver, B.C., Canada
June 24-25, 2018

American Academy of Pediatric Dentistry 71st Annual Session
Honolulu, Hawaii
May 24-27, 2018

American Association of Oral and Maxillofacial Surgeons (AAOMS) 100th Annual Meeting, Scientific Sessions and Exhibition
Chicago, Ill.
October 8-13, 2018

American Association of Oral and Maxillofacial Surgeons (AAOMS) Dental Implant Conference
Chicago, Ill.
November 29-December 1, 2018

American Cleft Palate-Craniofacial Association's (ACPA) 76th Annual Meeting
Tuscon, Ariz.
April 9-13, 2019

American Society for Bone and Mineral Research (ASBMR) 2018 Annual Meeting
Montreal, Canada
Sep28-Oct 1, 2018

American Student Dental Association (ASDA) Annual Session
Pittsburgh, Pa.
February 27-March 2, 2019

Experimental Biology Annual Meeting
Orlando, Fla.
April 6-9, 2019

First International Conference on Oral Mucosal Immunity and Microbiome
Chania, Crete, Greece
September 26-October 1, 2018

McGowan Institute Scientific Retreat
Pittsburgh, Pa.
March 12, 2019

Michigan-Pittsburgh-Wyss Regenerative Medicine Resource Center (MPWRM) 2018 Annual Stakeholders Summit
Pittsburgh, Pa.
July 10-11, 2018

Pittsburgh Academy of Periodontology
Pittsburgh, Pa.
October 10, 2018

Silk Road International Forum on Stomatology
Xian, China
September 25-29, 2018

Society for Experimental Biology Annual Meeting
Florence, Italy
July 2-6, 2018

Texas Dental Society of Anesthesiology 2018 Annual Scientific Session
San Antonio, Tex.
September 29, 2018

University of Michigan School of Dentistry 12th Ramfjord Symposium
Ann Arbor, Mich.
June 14-16, 2018

University of Pittsburgh School of Dental Medicine 18th Annual Research Symposium
Pittsburgh, Pa.
May 16, 2018

University of Pittsburgh School of Medicine Survivorship after Cancer of the Head and Neck: A Multidisciplinary Symposium
Pittsburgh, Pa.
August 6-7, 2018

University of Pittsburgh Science
Pittsburgh, Pa.
October 17-19, 2018

XVth International Magnesium Symposium "Magnesium in Health and Disease"
Bethesda, Md.
March 20-22, 2019

National Dental Advisory Council Annual Meeting
Amelia Island, Fla.
May 16-19, 2018

National Oral Health Conference
Louisville, Ky.
April 16-18, 2018

American Dental Education Association (ADEA) Annual Session and Exhibition
Orlando, Fla.
March 17-20, 2018

Rx Drug Abuse & Heroin Summit
Atlanta, Ga.
April 22-25, 2019

American Dental Association (ADA) Annual Meeting
Honolulu, Hawaii
October 18-22, 2018

Dental Society of Western Pennsylvania 2018 3Rivers Dental Conference
Nemacolin, Pa.
November 8, 2018

South Dakota Dental Society Annual Session
Rapid City, S.D.
May 16-18, 2018

Oral Epidemiology (Epi) Forum Satellite Symposium, IADR
London, England
July 24, 2018

Joint Statistical Meetings
Vancouver, BC, Canada
July 28-August 2, 2018

National Oral Health Conference
Memphis, Tenn.
April 15-17, 2019

American Academy of Endodontics (AAE) Annual Meeting
Denver, Colo.
April 25-28, 2019

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

International Society for Stem Cell Research (ISSCR) Annual Meeting
Melbourne, Australia
Jun 20-23, 2018

35th Annual Meeting of the Brazilian Division of the International Association for Dental Research (SBPqO)
Campinas, SP, Brazil
September 4,

Biomedical Engineering Society (BMES) Annual Meeting
Atlanta, Ga.
October 17-20, 2018

24th Annual Hinman Student Research Symposium
Memphis, Tenn.
November 2-4, 2018


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