



Herman Ostrow School
of Dentistry of USC

THE EXPLORER

Journal of USC Student Research



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Journal of USC Student Research

Herman Ostrow School of Dentistry of **USC**

FROM THE DEAN

Dear students and colleagues,

Every year, it is with great excitement that I await the arrival of Research Day, which, as many of you know, is one of USC's only days devoted exclusively to students' scientific inquiry. It gives me such satisfaction to see the curiosity and excitement on the faces of faculty and students as they talk about the results of their research. I especially enjoy seeing colleagues sharing their newfound knowledge with each other, allowing one great idea to spark another to spark another, which is precisely how scientific revolutions get their start. I can always count on learning something new each year, and I hope, after today, you can say the same.

As part of a research-intensive university, we at the Herman Ostrow School of Dentistry of USC take scientific inquiry and discovery very seriously. As many of you might know, Ostrow has consistently been the top-funded private dental school since 2012 by the National Institute of Dental and Craniofacial Research. There's perhaps no greater compliment than to have this national organization, which aims to improve oral, dental and craniofacial health through research, believe so strongly in the work that our researchers do every day.

This commitment to research doesn't stop with dentistry. Our colleagues at both the USC Chan Division of Occupational Science and Occupational Therapy and the USC Division of Biokinesiology and Physical Therapy, who join us here today, are also among the top thought leaders of their professions, regularly publishing high-impact journal articles that push their fields into ever-exciting directions.

We believe this focus on scientific inquiry, and to life-long learning in general, is critical for our students to go on to enjoy successful careers. The world our students will practice in is incredibly dynamic, with new technologies and innovative ideas changing the professional landscape all the time. The ability to think critically, to scrutinize data and to stay ahead of the constant changes will be imperative for future professionals in dentistry, occupational therapy and physical therapy to remain among the top of their professions.

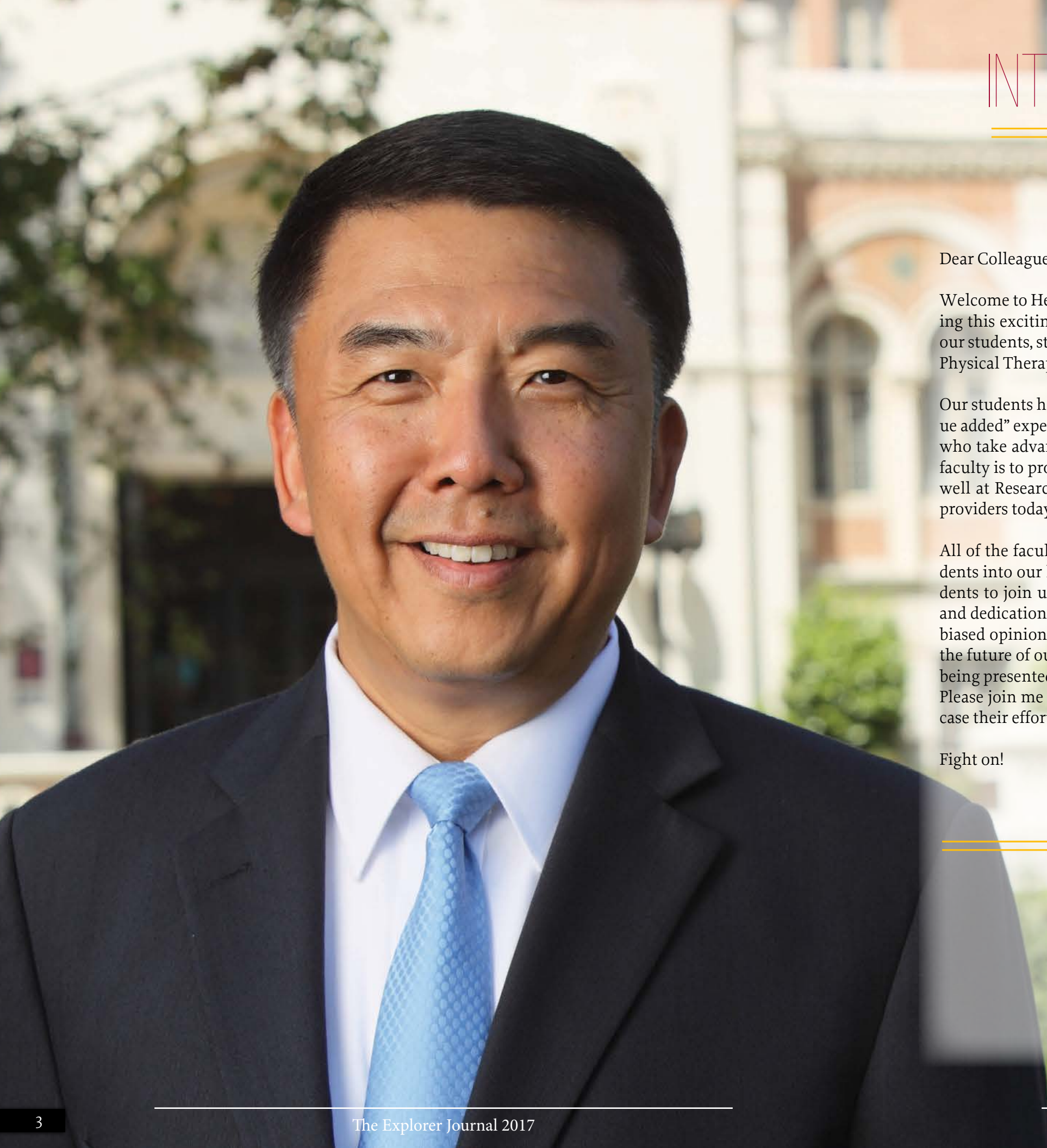
As we embark upon this day, I'd like to congratulate all our faculty and student researchers. I am incredibly proud of your hard work, dedication and your scientific curiosity.

Fight On!

*Avishai Sadan, DMD, MBA
Dean*

*G. Donald and Marian James Montgomery Professor of Dentistry
Herman Ostrow School of Dentistry of USC*





INTRODUCTION TO RESEARCH DAY

Dear Colleagues,

Welcome to Herman Ostrow School of Dentistry of USC Research Day 2017! Every year I look forward to hosting this exciting event at the Galen Center and seeing what groundbreaking research is being conducted by our students, staff, and faculty in Dentistry, Occupational Science, Occupational Therapy, Biokinesiology, and Physical Therapy.

Our students have the privilege to conduct cutting edge research during their time at USC. This is truly a “value added” experience that only a selected few top-tier research universities can offer, and I commend students who take advantage of this incredible opportunity. At USC, one of the goals shared by all of our life science faculty is to promote research that will improve health throughout the human lifespan. This is reflected very well at Research Day, which showcases research that will address challenging problems facing health care providers today. We see clearly how our research can benefit those from all walks of life, at all stages of life.

All of the faculty who conduct basic, translational, and clinical research at the Ostrow School welcome students into our laboratories. We strongly encourage motivated high school, undergraduate, and graduate students to join us and learn firsthand how the frontiers of science and medicine advance through hard work and dedication. We also strongly encourage our students to pursue academic careers, which—in my perhaps biased opinion—are highly rewarding and can make a tremendous impact on patient care. Our students are the future of our profession. We must invest in them. Based on the record number of outstanding discoveries being presented today, I am more confident than ever that our Trojan family is full of future academic leaders. Please join me in congratulating all of our students and researchers on their successes as we gather to showcase their efforts on Research Day.

Fight on!

Yang Chai, DDS, PhD

Professor

George and MaryLou Boone Chair in Craniofacial Molecular Biology

Associate Dean of Research

Director, Center for Craniofacial Molecular Biology

Herman Ostrow School of Dentistry of the University of Southern California

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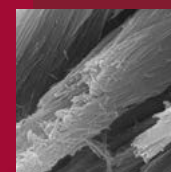
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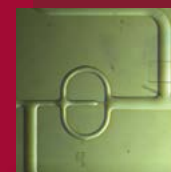
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ORAL DIAGNOSIS *Reinvisioned*

BY: DANIEL ADELPOUR '19 & JUDITH NAZIRI '19

BACKGROUND

The dental field is continually being revolutionized with new materials, tools, and technology. Dr. Glenn Clark is bringing that ingenuity to dental education. Dr. Clark is a Professor at the Herman Ostrow School of Dentistry and Director of the master's degree program in Orofacial Pain and Oral Medicine at USC.

The Orofacial Pain and Oral Medicine program is an interactive, hybrid online/in-person residency program. With 70 dentists currently enrolled, it is the largest program of its kind. A virtual patient system was created by Dr. Clark and Dr. Luciano Nocera from the Viterbi School of Engineering, and it is used in this program both for the purposes of training and as a final competency examination of the residents' knowledge.

These virtual patients are not textbook cases, Dr. Clark explains. "Some of these patients are complex patients drawn right from our clinic. They are people with real problems but who might not have all of the classic signs and symptoms." With the success of this program, Dr. Clark has also developed a truncated version and created a rotation for senior students to receive more exposure to the field.

HOW IT STARTED

Dr. Clark received his DDS degree from the UCLA School of Dentistry and then attended the University of Rochester, where he received a master's degree in dental research. He quickly found his passion for teaching after becoming a faculty member at UCLA. After teaching for over 27 years, he finally found his way to USC, where he was hired to create an advanced program in orofacial pain and mucosal diseases.

After getting the conventional two-year residency program running, he created an online program in 2012 to target practicing dentists as well as help current dental students have a better understanding of orofacial pain and mucosal diseases.

HOW IT WORKS

As mentioned above, the program uses anonymized data based on patients who were treated at the USC Orofacial Pain and Oral Medicine Clinic. Currently the virtual patient database contains over 120 cases with pathologies ranging from bone pathology, oral mucosal lesions, temporomandibular disorders, headaches, and neuropathies. The students are also provided with the associated medical history questionnaire data before the "interview" process begins. Through this program, both current dental students and practicing dentists are able to benefit by learning how to treat patients based on real-life cases and scenarios; they learn the thought process necessary in order to properly diagnose patients with challenging or unusual pathologies.

USC STUDENTS

In order to improve and develop the abilities of dental students to make clinical decisions, Dr. Clark requires that fourth-year dental students take his "DDS Detective" course as a one week rotation. The rotation is set up as a game in order to better engage the students. "Considering the availability of online resources, games are becoming an essential tool for educators," Dr. Clark states. "Some of the benefits of including virtual learning and games in education are increased retention and improved skill transfer to real-life situations." The program is divided into

four sections: case selection, patient interview, decisions, and feedback. After the student reviews the medical history questionnaires, he or she is presented with a picture, for example, of a lesion or some sort of asymmetry. From there the students can inquire further about their patient from a bank of about 400 different questions. Examples of questions include "What is your chief complaint?", "How long have you had this problem?", "How severe is the pain?", and "What medications are you taking?" Each question is followed by a response that leads the student to ask a new, relevant question.

After this question-and-answer session, students continue to the decision panel where they are able to order diagnostic tests. From this point on, students must make decisions in a linear fashion with no possibility of backtracking. This is where the students can gain or lose points. For example, if a biopsy is requested as a test, but the patient does not present with a lesion, this would result in a deduction of points. In order to complete the week-long course, students have to complete four cases and pass three. The goal of the game is to correctly diagnose the patient and prescribe the right medications, while asking questions and gathering cues in a logical and systematic way.

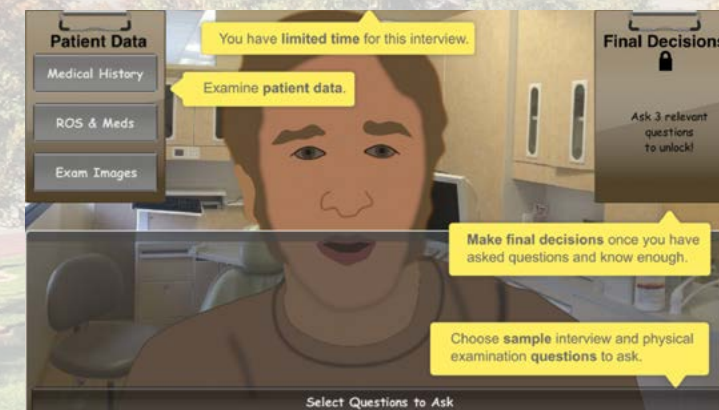
RESIDENCY PROGRAM

As for life after dental school, Dr. Clark noticed that in order for practicing dentists to further their knowledge and keep up

with new technologies, continuing education courses were the only outlet; he felt this was insufficient. In an effort to bridge the education gap, Dr. Clark developed the master's degree hybrid online program in Orofacial Pain and Oral Medicine. Each student is required to participate in several two-week "boot camps" where they are trained in a variety of skills. The students are then tested on these skills through an objective structured clinical evaluation (OSCE). In order for students to successfully graduate from this program, they must complete a thesis, put together a portfolio, take 17 courses, watch over 200 hours of lecture, and pass the OSCE.

WHAT'S NEXT

Due to the success of the program, Dr. Clark plans to expand his program with the help of Dr. Mariela Padilla, the Assistant Director of Distance Education. Dr. Clark envisions his programs continuing to grow both in size as well as in quantity. He hopes to add shorter one-year programs such as pain medicine, oral pathology and radiology, and orofacial pain. "I expect to be enrolling a class size every year that will be equal to the conventional advanced dentistry programs here, from about 100 to 150 students a year," Dr. Clark states. "I think we'll be a big part of advanced dentistry education. I think we're changing the face of graduate education in dentistry."



A SAMPLE CASE FROM DR. CLARK'S "DDS DETECTIVE" WEBSITE USED TO EDUCATE STUDENTS ON DIAGNOSTIC TECHNIQUES.

Computer-Guided Orthodontics

with Dan Grauer

BY: CORY NASOFF '19 & PAYAM SHAAF '19

Dr. Dan Grauer is an Assistant Professor of Clinical Dentistry at the Herman Ostrow School of Dentistry of USC. His orthodontic practice specializes in lingual braces and he serves on the editorial board of professional publications including the American Journal of Orthodontics and Dentofacial Orthopedics.

After completing his bachelor's degree in dental surgery and master's degree in orthodontics at the University of Barcelona, Dr. Grauer was still hungry for more wisdom and decided to continue his educa-

tion in the United States with the help of a prestigious La Caixa Scholarship.

In the U.S., Dr. Grauer began his journey at the University of North Carolina (UNC) at Chapel Hill. He received another master's degree, specialty certificate in orthodontics, doctor of dental surgery degree, and Ph.D. in Oral Biology. He then completed a post-doctoral fellowship at UNC under the mentorship of Dr. William Proffit, known as the father of contemporary orthodontics.

Dr. Grauer joined the USC School of Dentistry in 2012, where he began teaching

in the advanced orthodontic program. Currently, he teaches classes in diagnosis and treatment planning, biomechanics, biomineralization, interdisciplinary orthodontics, and the application of technology in orthodontics. He also runs an orthodontic practice in Santa Monica, where he is the largest provider of fully customized hidden braces. As a respected researcher, he lectures at meetings domestically and internationally and also serves on the editorial board of professional publications. He organizes a bi-annual meeting in Barcelona that invites the best professionals from the U.S. and Europe, attracting people from more than 35 countries.

He was elected as an associate editor of the *American Journal of Orthodontics* and *Dentofacial Orthopedics* (AJODO) in 2010. His role involves editing a section called "Residents Journal Review." In this section, residents from 48 accredited orthodontic programs in the U.S. and Canada choose published articles that a normal orthodontist would not have access to. These articles are reviewed and critiqued. Every month, three to eight article reviews are published in the AJODO.

This way, the residents are published in the journal alongside innovative articles.

Dr. Grauer is an expert on lingual braces and has studied their precision and accuracy. With lingual braces, there are five times fewer carious lesions due to decalcification, and if there are white spot lesions, they are ten times smaller. This is because there is more saliva on the lingual side of teeth and lingual braces are better adapted to the surface of the enam-

plains how this new method works by first taking a three-dimensional radiograph of the head and photos at different angles to determine where the teeth are located relative to the lips and face. Then, the positions of the teeth are prepared so that the target smile is visualized relative to the lips and face. The other important component is a customized appliance, where there is a computer process that models the target result and presents a mock-up. Unlike the conventional treatment plan,

es in the face. Just recently, Dr. Paula Zabalegui, a resident working with Dr. Grauer on his latest project, which looks at the difference in condyle positioning before and after orthognathic surgery, was awarded the Advanced Orthodontic Research Award and the American Association of Orthodontists Graber Award. When orthognathic surgery is performed on a patient, the positions of the condyles relative to the glenoid fossa should not be altered. Dr. Grauer and his team have



"TODAY NO ONE NEEDS TO KNOW THAT YOU HAVE BRACES. LINGUAL BRACES ARE THE MOST INVISIBLE OPTION TO CORRECT YOUR SMILE AND OCCLUSION. ONLY YOU WILL KNOW YOU ARE WEARING BRACES"
- DR. GRAUER

el. The second advantage is that they are completely invisible, not semi-invisible like Invisalign. Like patients fitted with labial braces, those receiving lingual braces take a few weeks to adapt.

In traditional orthodontics, the size of the brackets and the shape of the wires are based on average values used by 95 to 98 percent of orthodontists. Today, Dr. Grauer has developed facially-driven computer-guided orthodontics, which focuses on the face along with the positioning of teeth to improve the overall smile. He ex-

a bracket is customized and fabricated for every tooth with three-dimensional printers. The wires are made based on the shape of the patient's jaw and the shape of the dental arches that will be achieved. Ultimately, this computer-guided process begins with the end goal in mind and produces clear cut results. It also decreases treatment time by up to one third.

Dr. Grauer also performs research in interdisciplinary treatment planning, which involves orthognathic surgery, the position of the condyles, and chang-

therefore developed a method to register and superimpose the condyles based on the position of the glenoid fossa between two time points, before surgery and after surgery. They can now measure, in three dimensions the displacement and rotation of the condyles. There are currently a sample of 35 patients and their data is reported in the *American Journal of Orthodontics* and *Dentofacial Orthopedics*.

As a practitioner, educator, and researcher, Dr. Grauer is an innovator and influencer in his field of orthodontics.



Advancing Techniques in Craniofacial Surgery

By: Rachna Shenoy '18 & Iriff Ulep '19

The field of oral and maxillofacial surgery has evolved in scope to traverse both medical and dental specialties. While grounded in a strong foundation of dentoalveolar principles, oral surgeons now perform facial reconstruction, cosmetic surgery, head and neck dissections, and other maxillofacial procedures. Drawing from principles of otolaryngology and plastic surgery, oral surgery demands focus, precision, and innovative thinking. At the forefront of this field and upholding these principles is Dr. Jeffrey Hammoudeh, a dual-degree, double doctorate of oral and plastic surgery, as well as a pediatric craniofacial specialist.

Dr. Hammoudeh, a graduate of both Northwestern Dental and Medical School, received extensive training in both clinical oral and maxillofacial surgery as well as plastic surgery. Following dental school, Dr. Hammoudeh trained at Rush Presbyterian Hospital and Northwestern Memorial Hospital, completing surgical internships in oral surgery and general surgery. He then continued his general surgery prerequisites at the prestigious Massachusetts General Hospital (MGH) and subsequently finished an oral and maxillofacial residency through MGH's associated Harvard program. Desiring further training in plastics and reconstruction, Dr. Hammoudeh completed formal plastic and reconstructive surgery training at the University of Miami/Jackson Memorial Hospital. Taking a special interest in pediatric and craniofacial development, he completed a fellowship at the Children's Hospital of Los Angeles (CHLA) in pediatric plastic and craniofacial surgery. This one-year fellowship is what brought Dr. Hammoudeh to the Los Angeles area and to the University of Southern California.

It is no wonder that someone with such impressive training and extensive knowledge of the wide range of specialties constellating around oral surgery would land at CHLA, which houses one of the nation's premier craniofacial teams. Still, Dr. Hammoudeh insists that he has taken a roundabout path to practicing in pediatric surgery, stating that he was constantly searching for his place in such a vast field. He said, "I never had an 'aha' moment. I was always looking for my niche. I was looking for where I fit in into this whole strange world." Early on in dental school, Dr. Hammoudeh craved a challenge. Unstimulated by general den-

tistry and restorative sciences, he was drawn to oral and maxillofacial surgery due to its pace and scope. The program chief at Northwestern Dental School, an ear, nose, throat (ENT) surgeon, allowed Dr. Hammoudeh to witness unusual and fascinating cases such as neck dissections, cancers, and tracheostomies. The practical and hands-on approach provided stark contrast to the didactic education he was receiving in dental school and sparked his interest in craniofacial surgery more generally.

Perhaps it was his early exposure to the unusual cases that crossed over into ENT surgical specialties that spurred Dr. Hammoudeh's interest in pursuing post-doctoral craniofacial training. His desire to have a broad-based understanding of maxillofacial structures led him to apply to an extra general surgery residency, followed by further training in plastics and oral surgery. One of the major challenges he faced throughout his training was how to continue expanding the scope of his work in oral surgery without encroaching on the scope of practice of other surgical specialties. Dr. Hammoudeh describes being interested in complex and intricate cases that were out of scope of the traditionally trained oral surgeon. Throughout his training he pushed the boundaries of oral surgery. "I was interested in plastic surgery, which is a specialty of medicine, knowing I was going to circle back around and do craniofacial," he says. "I didn't really do plastic surgery to really be doing a lot of cosmetic surgery. I did it because I wanted to do craniofacial surgery and to do the full scope of craniofacial surgery. It's hard to do it as an oral surgeon alone. It's not that it's impossible, it's just a little bit difficult."

What many view as impossible is truly "just a little bit more difficult" to Dr. Hammoudeh. This also characterizes his innovative research. He states, "I got into clinical research by accident. What happens is you try to push the envelope, and you try to change paradigms." While training at CHLA, Dr. Hammoudeh was involved in many cases involving children born with craniofacial abnormalities and specifically cleft lip and palate. This condition, caused by an incomplete fusion of the nasal and intermaxillary processes, is typically treated in the United States with numerous corrective surgeries and extensive orthodontic treatment from birth through adolescence in order to restore closure, function, phonetics, and esthetics of the lips and palate. For children born with cleft lip and palate who are treated at hospitals such as CHLA, a team consisting of oral surgeons, plastic surgeons, prosthodontists, orthodontists, and speech therapists plans appropriate treatment beginning in early infancy. The traditional timeline to repair the defect begins with the first surgery between the ages of three and six months. Prior to the first surgery, a process called nasoalveolar moulding, or NAM, is often undertaken. In NAM, the child wears a device that decreases the width of the cleft by constraining the alveolus and elevating the nose, improving the eventual surgical outcome. Until surgical repair is completed, the child's ability to feed is of primary concern, and the extra care required by the child may be a strain on the parents. It is a difficult time for many families.

Always thinking critically and pushing the standard of care, Dr. Hammoudeh sought to find a solution for the delay in surgical treatment of children with cleft lip and palate. He states, "you're born with this deformity and you have to wait five to six months. What can we do to repair this earlier?" As an innovator and engineer of pragmatic solutions, he designed a protocol, obtained Institutional Review Board approval to conduct a study, and estab-



lished clinical trials. To date, he has conducted fifty cases of cleft lip repair at two weeks of life. The result, he says, is monumentally impactful on both the child and the family. He recalls families who want to take their children out in public but refrain from doing so due to the constant questioning about their child's condition. Dr. Hammoudeh comments, "[These parents] love their child the same as kids that are born without cleft lip/cleft palate, but there is that burden that they carry." By eliminating five months of waiting for cleft lip and palate repair, Dr. Hammoudeh and his team have provided a safe and effective acceleration of the timeline for a surgery that transforms a young child's life.

When asked about his motivation for entering clinical research, Dr. Hammoudeh calls it "the impact factor." He states that he approaches research on a case-by-case basis, witnessing complicated treatments in the hospital and attempting to find a more efficient and effective solution. His pragmatic style of thinking has led to transformations in treatment for children with Pierre Robin syndrome, a congenital abnormality that results in retrognathia, cleft palate, and airway obstruction. He conducts distraction procedures that include osteotomy followed by advancement of the jaw, thus avoiding a tracheostomy and reducing morbidity and mortality by about fifteen to twenty percent. Dr. Hammoudeh comments that for him, the "impact factor" is much higher in children. Clinical research has allowed him to change treatment

paradigms and have an impact on a child's care immediately. This impact factor, combined with the desire to improve care for children, technical ability, and perseverance, that has spurred Dr. Hammoudeh to professional success.

Such an accomplished and highly trained surgeon must have an array of professional mentors, but when asked about his most impactful experience, Dr. Hammoudeh surprisingly cites college athletics as his biggest inspiration. He shares that he attended college on a football scholarship and originally aspired to play in the NFL. He believes his greatest influences were his five years of college training, being part of a team, and being pushed physically and mentally with high academic and athletic expectations. He calls it "unusual and strange training," but states, "That tenacity that you would have to excel athletically is the same tenacity needed to excel academically."

There is a vast amount of truth to what Dr. Hammoudeh says. Searching so many years to find his niche in the surgical field has provided him with a diverse spectrum of influences that have shaped his approach and technique. What began as a journey to find a niche in a complex field culminated in the emergence of an innovative, yet pragmatic surgeon dedicated to meaningfully impacting his patients while advancing the cutting edge of techniques in craniofacial surgery.



Pre-operative picture (Left) of a 2 weeks old patient with cleft lip and post-operative picture (right) of the same patient 3 months following the surgical treatment.

Revolutionizing Dental Care for Special Patients

By: Ruhee Jaffer '19 & Meha Patel '18

Dr. Phuu Han has been deeply invested in the field of dentistry for many years. Her journey began in Yangon, Myanmar where she completed her Bachelor's Degree in Dental Surgery at the Institute of Dental Medicine. Dr. Han then continued her studies in Japan, where she received her Ph.D. from Okayama University. Her doctoral research was in tumor behavior and development, and she wrote her dissertation on "Differential Gene and Protein Expressions in Odontogenic Tumors." After many years of being engaged in histopathology and research, she wanted to integrate her experience into clinical practice. Her passion for patient care led her to the USC, where she completed her residency certificate in Orofacial Pain and Oral Medicine. While completing her degree, she had a deep affinity for treating a range of complex cases from temporomandibular joint disorders to neurofacial developmental issues. She then finished the Advanced Standing Program for International Dentist and received her Doctor of Dental Surgery degree at USC.

The diversity in the fabric of her experience is interwoven with her work in geriatric care, the special patient population, medically complex cases, and interdisciplinary care. Under the auspices of Dr. Roseann Mulligan, she has recently been involved in developing a master's level geriatric dentistry curriculum. With the continuously aging population, there is a strong impetus to improve geriatric care. This new degree program, offered by USC, is the first of its kind. It is a hybrid program where 80 percent of the coursework is offered via an online platform. This successful program launched in 2012 and graduated its first certificate cohort in 2014, while the first class of the master's program will graduate in 2017.

Geriatric patients are a particularly disadvantaged population. Clinical research catered towards the geriatric patient is limited in part because the older patient often has multiple compounded medical conditions. In clinical trials of new medications and materials, the patient pool is commonly middle-aged. The interactions between multiple medications and declining health make it difficult to use geriatric subjects in such trials. In addition to all this, convincing geriatric patients to change their behaviors can be more difficult. In August 2016, Dr. Han, along with Dr. Mulligan and Dr. Piedad Suarez, published a book chapter addressing this topic titled "Preventive Considerations in Special Care Dentistry" in *Prevention Across the Lifespan: A Review of Evidence-Based Interventions for Common Oral Health Conditions*. Evidence-based research indicates that an aggressive preventive oral health program is necessary for the young and middle-aged adults. The aim of this program is to alter habits and form healthier behaviors that can serve an individual for a lifetime.

As medicine has advanced, there has been a shift in the type of care that a geriatric patient requires. More geriatric patients are faced with xerostomia (dry mouth), in part due to their sometimes extensive medication regimens. This

negatively impacts their oral health and should thus be mitigated as part of a preventive care strategy. In the article "Dry mouth: A critical topic for older adult patients," Dr. Han and her co-authors highlight the importance of understanding the etiology behind dry mouth in order to offer the appropriate treatment.

In addition to xerostomia, there are a growing number of older patients who face kidney-related illnesses. In the past, patients with renal issues were treated very infrequently and the available treatment options were limited. Dr. Han recently co-authored and published an article with Ursula Reyes and Dr. Ann Spolarich entitled A Comprehensive Oral Preventive Care Protocol for Caring for the Renal Transplant Population (2016), which discusses caring for this population. An appropriate oral care regimen must be provided to the renal patient. Prioritizing adequate dental care can help to prevent oral in-

PRIORITIZING ADEQUATE DENTAL CARE CAN HELP TO PREVENT ORAL INFECTIONS AND IMPROVE THE OVERALL HEALTH AND QUALITY OF LIFE
-DR. PHUU HAN

fections and improve the overall health and quality of life for patients with renal failure or transplants.

Additionally, in recent years there are more geriatric patients living with the human immunodeficiency virus (HIV) than in the past. With the advancements in highly active anti-retroviral therapy, patients with HIV are living longer and healthier lives. Many patients have been on this cocktail-therapy for several years now. As they ease into their older years, there is a whole new host of issues that the oral health care provider must recognize and treat. A well-developed oral health program can prevent any adverse sequelae of HIV and aging.

Dr. Han has been instrumental in another forum as well – the Interprofessional Education (IPE) program. Dr. Han, along with Dr. Jeremy Teoh, has dedicated her

time to promoting integrative health care via IPE seminars. Currently, the healthcare system is extremely segregated. The interaction of various healthcare professionals tending to a single patient is very limited. By offering holistic patient-centered care, the outcomes and health of a patient can be significantly improved. The IPE sessions have been very well received. Some of the programs encompassed under the Interprofessional initiative include the Interprofessional Geriatric Curriculum, Pro-Active Health Fair, and Interprofessional Day. Dr. Han has played a pivotal role in the foundation of the IPE curriculum. The IPE sessions are offered to select students from across the healthcare spectrum. During Interprofessional Day, a panel of speakers from a variety of healthcare professions are invited to discuss their scope of practice and role as part of a health care team, and how collaborative care can be applied in the clinical setting. The goal of these sessions is to foster discussion among students from different disciplines and help to provide them with a basic understanding of the role of their colleagues.

Due to the success of these programs, Dr. Teoh received a grant to further this mission. A small pilot program was launched with twenty 3rd and 4th year dental students who had the opportunity to interact with health professionals from seven different professions. All the participating students and residents focus on longitudinal care (over a one-year period) at the Tres Lomas retirement community. The ultimate mission is to help students from across the healthcare spectrum utilize each other to provide the most optimal patient care.

Dr. Han has been heavily involved with a multitude of other programs offered at USC. Some of these include the Children Health and Maintenance Program (CHAMP), County Geriatrics Clinics and the Hollenbeck Nursing Facility. Dr. Han has a broad range of interests focused on improving patient care for marginalized population groups and is certainly revolutionizing the approach to patient-centered care.

Ostrow School
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of USC

DEDICATION IN PEDIATRIC DENTISTRY

BY: MONA DOUSTI '18 & LEORA SHEILY '18

Tucked away in the basement of Herman Ostrow School of Dentistry of USC, you can find the fun-loving and upbeat Pediatric Dentistry Clinic. This is also where you can find Dr. Annie Huang, who is not only a successful clinician but also a mentor for the pediatric dentistry residents. Dr. Huang received her D.M.D. from the Harvard School of Dental Medicine in 2012. Her schooling continued as she completed her pediatric dentistry residency here at USC in 2014. Soon after completing her pediatric training, Dr. Huang became an Assistant Professor of Clinical Dentistry in the Division of Dental Public Health and Pediatric Dentistry at USC, as well as an attending dentist in the Division of Dentistry at Children's Hospital of Los Angeles (CHLA).

Dr. Huang always wanted to have a career in healthcare and participated in many volunteer projects during her undergraduate studies at the University of Georgia. Seeing the need for oral healthcare in the population surrounding the university, Dr. Huang volunteered at Mercy Health Clinic in Athens, Georgia to help deliver care to the underprivileged. These volunteer experiences drew her into the profession of dentistry because she found them to be especially rewarding.

Dr. Huang didn't truly know how strongly she felt about pediatric dentistry until she treated children in dental school. At Harvard, Dr. Huang had a strong exposure to pediatric dentistry not only within the dental school curriculum and clinic, but also with a month-long externship at Boston Children's Hospital and at several monthly volunteer clinics serving the indigent pediatric population in Boston. Dr. Huang also helped create a curriculum along with some of her medical and dental colleagues on various teen health topics; she administered these weekly lectures to at-risk middle school students for a semester.

Her experiences in dental school were well-rounded in several facets of treating the pediatric patient. She loves kids and clearly has the energy required to treat this patient population. Dr. Huang enjoys the breadth of pediatric den-

tistry and how the field is only age-defined and not procedure-defined. She also notes that the specialty requires clinicians to constantly be working at high efficiency.

Dr. Huang states that a key component of pediatric dentistry is understanding and being able to implement behavior management techniques effectively and safely. Several factors are key in administering proper care - not only for the safety of the patient and staff, but also for the mental well-being of the patient. When treating a young child, positive experiences are instrumental in maintaining a positive outlook that the young patient will carry in regards to oral health throughout life. This was one of the most important lessons that Dr. Huang learned throughout residency and continues to learn with each patient in practice.

Dr. Huang began dipping her toe in research during college, where she worked for two years in a genetics lab under the guidance of Dr. Daniel Promislow. This bench top research gave her the opportunity to learn the fundamentals and inspired her to continue with research, both during dental school and beyond. While at Harvard, Dr. Huang traveled to South Africa for eight weeks, where she investigated the system of nutritional education in the Port Elizabeth Health Complex hospitals by examining the disparity in nutrition knowledge between clinicians and patients with HIV/AIDS. Her study also assessed the capability of patients to adhere to nutritional guidelines and their food security. To optimize the quality of this investigation, Dr. Huang planned and worked tirelessly for an entire year prior to traveling to South Africa.

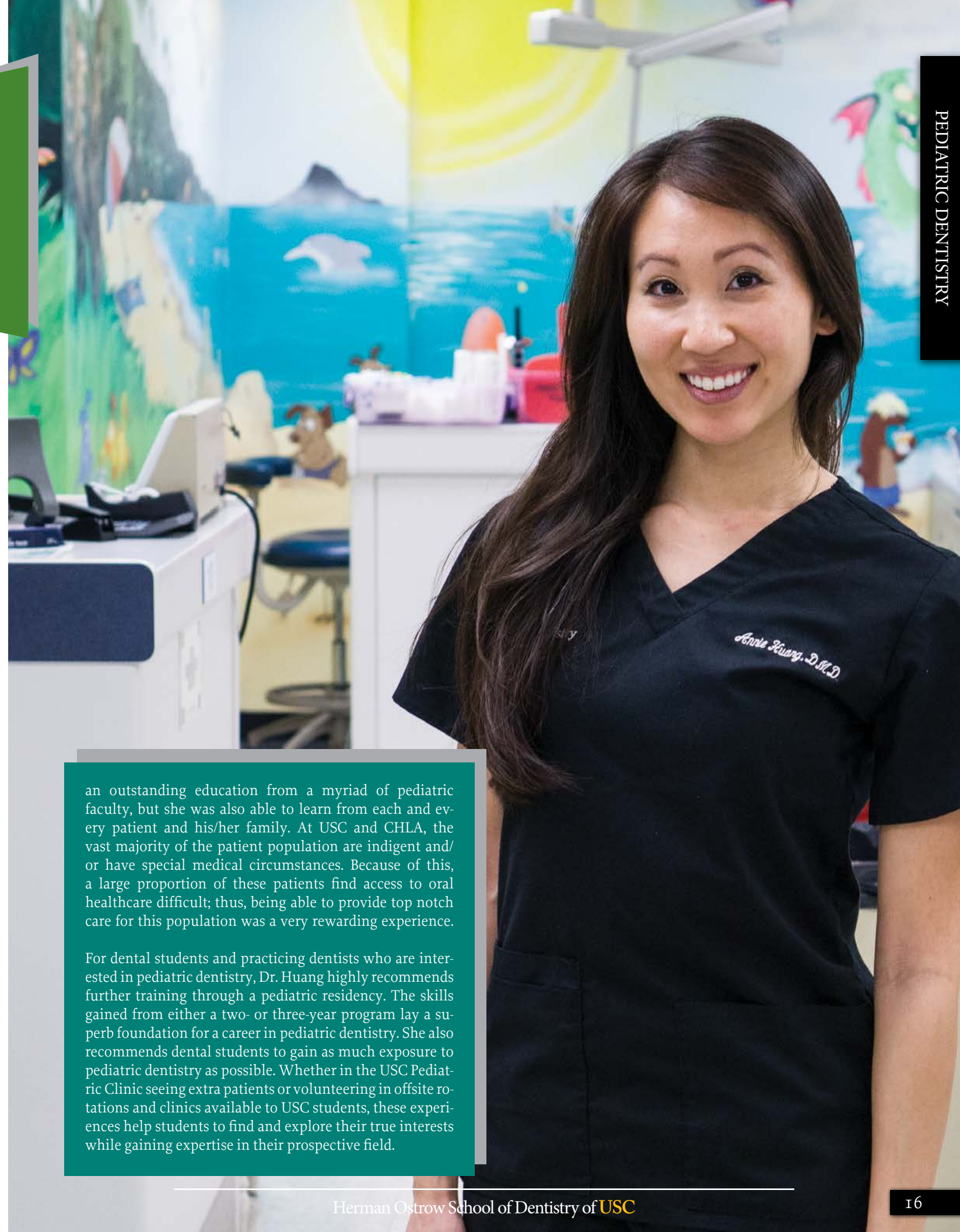
During her pediatric dentistry residency, Dr. Huang conducted research with Dr. Thomas Tanbonliong on the post-discharge adverse events following oral sedation in the pediatric dental patient in hopes of better educating caregivers. Dr. Huang believes that sedation is an important issue for all dentists treating the pediatric patient. Pediatric residents at USC are trained in several different methods of sedation and develop a thorough knowledge base on how to sedate safely. Currently, Dr. Huang and Dr. Tanbonliong are working with pediatric residents on a follow-up study to her original investigation on oral sedation, but this time they are using two different sedation regimens for comparison.

Another study led by Dr. Huang with a previous pediatric resident investigated the level of oral health knowledge in nurses. Stressing the importance of educating nurses about oral health and prevention is crucial because nurses are often the first point of contact with pediatric patients and their parents, and as a result nurses are a great resource in educating them. Currently, this study is undergoing further data analysis in preparation for publication.

Dr. Huang states that her two years of training at USC and CHLA were invaluable in preparing her for her career in research and dentistry. Not only did she receive

an outstanding education from a myriad of pediatric faculty, but she was also able to learn from each and every patient and his/her family. At USC and CHLA, the vast majority of the patient population are indigent and/or have special medical circumstances. Because of this, a large proportion of these patients find access to oral healthcare difficult; thus, being able to provide top notch care for this population was a very rewarding experience.

For dental students and practicing dentists who are interested in pediatric dentistry, Dr. Huang highly recommends further training through a pediatric residency. The skills gained from either a two- or three-year program lay a superb foundation for a career in pediatric dentistry. She also recommends dental students to gain as much exposure to pediatric dentistry as possible. Whether in the USC Pediatric Clinic seeing extra patients or volunteering in offsite rotations and clinics available to USC students, these experiences help students to find and explore their true interests while gaining expertise in their prospective field.



“You must be the change you want to see in the world” - a simple saying from Gandhi, yet a powerful tool that influences great doctors such as Dr. Kian Kar to do their best with grace.

Dr. Kar is the Clinical Director of Advanced Periodontology at the Herman Ostrow School of Dentistry of USC. Dr. Kar's interesting journey started in Iran, where he received his initial dental education at Azad University from 1986-1992. He moved to the United States later that year and continued his education in the International Student Program (ISP) at USC. He received his DDS degree in 1995 from USC, completed a one-year preceptorship in 1996, and subsequently received a certificate in Periodontology after completing a post-graduate training program in periodontology and implant dentistry at USC in 1999. During his residency, he also completed a Master's degree in craniofacial biology in 2000, for which he conducted research on the immunology of periodontal disease.

Dr. Kar's interest in periodontology was triggered in his second year of dental school in Iran when he would assist his father, a practicing general dentist, chairside. He noticed a lot of patients had periodontitis and was left awestruck by the superior results and benefits of periodontal treatment. His interest was amplified when he observed that how some young patients who suffered from aggressive periodontitis would benefit from early periodontal treatment. This realization was enough to help keep his curiosity alive in finding a solution as to why this condition exists and why it affects different people differently.

His interest in research began while he pursued training at USC, when he looked at the immune pathogens that cause periodontal disease. He believed understanding the immuno-inflammatory nature of periodontal disease was very important. In addition to plaque, he also believed there were other contributing factors in the progression of this disease that warranted further study. This drew Dr. Kar's attention to the mechanisms of inflammation and immunity. He was mentored by Dr. Homayoun Zadeh and Dr. Jorgen Slots. He looked into the immunological aspect of periodontal disease and T cells involved in periodontal disease and be-

LEARNING MAY NEVER BE PAUSED

Discovering True Research from the Words of Dr. Kian Kar

By: Shruti Dandu '18
& Edmond Onwukwe '20



gan to study the disease at the cellular and molecular level. Dr. Kar saw these as highly complementary because they both reinforced his curiosity in immunology and clinical periodontology. His research took a total of six dedicated years and was published in *Journal of Periodontal Research* in 1999. Clinically, Dr. Kar was mentored by Dr. Hessam Nowzari, former Director of Advanced Periodontology program at USC, as well as Dr. Winston Chee and Dr. George Cho, Directors of Advanced Prosthodontics and Implant Dentistry, during his residency in Periodontology and clinical research in Implantology.

Dr. Kar's contribution to finding answers through research did not stop there. He has continued to contribute in many ways, including being a member of the editorial board for renowned journals like *California Dental Journal*, *the Journal of Oral Implantology*, and *the Journal of Periodontology*. In 2011 an article written by Dr. Kar entitled “Aggressive Periodontitis” was published in the *California Dental Association Journal*. The article discusses the pathophysiology of aggressive periodontitis and how it influences implant dentistry. Another article written by Dr. Kar, “Teeth in the Era of Implant Dentistry”, was published in 2014 and discusses controversies in the treatment planning of teeth and implants.

As the Clinical Director of Advanced Periodontology here at the Herman Ostrow School of Dentistry at USC, Dr. Kar is responsible for the implementation, oversight and day-to-day management of students treating patients. This includes not only providing outstanding dental treatment, but also updating and educating patients regarding the surgeries they will undergo and how they will benefit from those surgeries. He evaluates the various surgical procedures performed and makes appropriate suggestions and recommendations for improving the techniques. Throughout all of this, he ensures that the needs of patients are met in accordance with the highest professional standards of dental care.

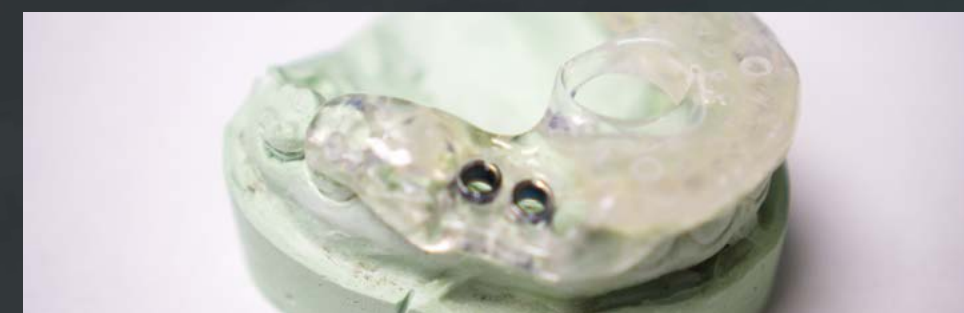
Dr. Kar's other ongoing projects include clinical studies in periodontology and evaluation of Guided Implant Surgery and soft tissue outcomes of flap access and flapless placement of dental implants. Furthermore, he is interested in careful

analysis of published studies, with the goal of implementing the best evidence-based techniques. From the methodology, study criteria, and statistical analysis to the conclusion, Dr. Kar approaches every article in a very detailed manner. This eagerness to learn is infectious, and his ingrained predisposition towards research is apparent in his approach to training residents. This interest has led to mentoring four Master's degree projects of advanced periodontology residents in 2015. The lead investigator of this series of projects, Dr. Satish Kumar, was recognized as the winner of the Balnit Orban Award from the American Academy of Periodontology in 2015.

Apart from his busy academic schedule, Dr. Kar also serves as an active member of several professional organizations, including the American Academy of Periodontology Education Committee as well as previously the California Society of Periodontist Education Committee. Dr. Kar also treats patients part time at the Herman Ostrow School of Dentistry Faculty Practice and his private practice in Orange County.

Dr. Kar is an excellent educator and periodontist who has received awards for his work on the immunology of periodontal disease. He gives back to the community by mentoring residents, doing research, and supervising the dentistry being performed in clinic. With his tremendous experience in periodontal disease, dental implants and guided surgery, he hopes to educate dental students in understanding surgical concepts in implant dentistry through guided surgery. He has a long track record of mentoring students and residents who have gone on to become elite clinicians and hopes to inspire more people to continue seeking truth in dentistry. In 2013, he was the recipient of Mellon Mentorship Award from University of Southern California and the recipient of American Academy of Periodontology Educator Award in recognition of Outstanding Teaching and Mentoring in Periodontics.

It is clearly evident from Dr. Kar's words that dedication, hard work and belief in oneself will bring success. His strong reputation, along with his prominence in research, are an inspiration to many.



Two implants are digitally planned for guided implant surgery. Guided surgery is a great educational tool to understand surgical parameters of proper implant placement to fulfill the restorative requirement for implant supported restorations. Implants are placed digitally according to the radiographic guide of planned restorations. A surgical guide is fabricated based on a digital plan and at the surgical appointment will be used clinically to guide osteotomy and implant placement according to the digital plan.



INNOVATION IN *Education*

BY: ARIANA RODRIGUEZ '20 & AZZAH WIDATALLA '20

Despite the myriad challenges that comes with educating dental students and conducting research, Dr. Thomas Levy, an Associate Professor of Clinical Dentistry and the Director of the Advanced Endodontics Clinic at the Herman Ostrow School of Dentistry of USC, is revitalized by these two fields. Dr. Levy received his DDS degree in 1975 and his Master's in Oral Biology in 1978 from the University of Pacific. After graduating with an endodontics certificate, he took over his father's clinic and practiced as an endodontist for twenty-three years. However, even after taking on a partner, Dr. Levy grew weary of working as a specialist and made an unconventional career choice. He diverted from the path of dentistry and pursued a career as a car salesman. While he was working at car dealerships, Dr. Levy started as a part-time volunteer instructor for the Advanced Standing Program for International Dentists (ASPID), which then led to a full-time position. His volunteering reenergized his interest in dentistry and led to an unwavering stewardship of the educational needs of the students of USC. Dr. Levy was one of only a handful of ASPID volunteers to work full time, and his dedication to his students continued as he transitioned into a graduate and an undergraduate instructor.

Adding to his personal enthusiasm for teaching, Dr. Levy has also had an inclination towards research. He has been a part of many research endeavors, such as bone grafting research for a company in El Salvador and research on a device that diagnoses different types of tooth fractures. One of his published works, featured in the *Journal of Endodontics*, explores the bacterial DNA present in peri-iridicular lesions of symptomatic teeth. He is also currently working on a project

that aims to compare the healing rate of the dental pulp of patients infected with HIV who are on anti-viral medications with those who are not. This interest in HIV and oral health stemmed from the fact that Ostrow's endodontic clinic sees over 400 HIV-infected patients a year. More than 100 HIV-positive patients have been tested so far, and this will be one of the first dental studies that utilizes such a large sample size. According to Dr. Levy, "The ultimate goal of this project is to understand the effect of anti-viral medication on dental bacteria and biofilm." This study may even challenge the standard dental procedures for HIV-infected patients and lead to new recommendations that could improve the treatment of HIV patients on anti-viral medications.

Furthermore, Dr. Levy is deeply invested in and enthusiastic about the education of millennials. Currently, he is investigating new methods for better instructing dental students in the art of diagnostics. The Avatar Project, currently in its infancy, is a dynamic program that allows students to practice diagnosing different types of patients. Dr. Levy believes that students will feel more confident when they encounter different types of patients after graduation, thanks to the exposure they will encounter during the Avatar Project. Students will be able to internalize these experiences and say, "I have seen this and have been with this type of patient before. I know how to handle this." The Sociology Department at USC is developing the Avatar software and tailoring the dialogues in the situations presented by the software to the dental field. "We want to teach the dentist how to interact with the patient and put [the students] in different situations that we can't do in lectures," says Dr. Levy. Avatar will be made easily accessible to students



through Blackboard – an online course management system commonly used at USC. In addition, every student will have their own personal avatar. This will allow students to gain even more experience before they graduate. The conception of the Avatar Project stemmed from the concept of the "flipped classroom". This method of education replaces long and sometimes tedious lectures with short 10- to 15-minute presentations that introduce new concepts, which students view on Blackboard prior to discussing the materials in the classroom. Another component of this educational style is an emphasis on learning in group settings. While in these groups, the students will simulate performing certain procedures on each other. This allows the students to experience what patients feel. "The students seem to enjoy it more," Dr. Levy believes. Also, another avenue that caters to the education of millennials is the use of an application called "Kahoot," which allows professors to modify lectures based on student performance in quizzes given throughout the lecture.

In addition to his research and teaching ventures, Dr. Levy is deeply engaged in community outreach. In 2012, the Califor-

nia Dental Association (CDA) honored Dr. Levy with its Dr. Arthur A. Dugoni Faculty Award. This award was given to applaud Dr. Levy for what the CDA explains as "exceptional leadership, innovation, collaboration, compassion, philanthropic spirit and integrity in dental education." He is a leader in the Department of Veterans Affairs' Stand Downs, which provides dental services to homeless veterans, and he also personally donates to

BASED ON RESEARCH, DR. LEVY CONSTANTLY CHALLENGES US TO THINK CRITICALLY IN EVERY FACET OF OUR ENDODONTIC ENDEAVOR.
-DR. STEPHEN PARK

the American College of Endodontics' Endowment Fund and USC's Give Back to the Community Education Fund to support research.

When asked about his reasons for spending his time serving the community, Dr. Levy recalled a recent experience that inspired and assured his altruistic actions towards the community. A disabled US veteran in a wheelchair arrived at the Stand Down clinic, and because the patients were being treat-

ed in mobile clinics, this determined veteran crawled his way into the clinic truck. He then pleaded to be treated for six decaying anterior teeth. One of Dr. Levy's residents treated the veteran and was able to give him a smile that would allow him to attend job interviews with confidence and get his life back on track. The veteran's gratitude for the resident's work left the resident emotional about the impact he made on this patient's life. Dr. Levy thinks about this moment every time he decides to pursue more volunteer work.

Dr. Levy is a distinguished researcher, with a passion for educating the next generation of healthcare providers. Moreover, he is equally committed to his own continuing education, and plans to pursue a master's degree in geriatrics in the next few years. His dedication to the betterment of the education system is clear through his innovative research in adapting the education style towards the mindset of his students. Although most would be intimidated by the amount of work that needs to be accomplished as an educator and a researcher, he finds great enjoyment and energy in these endeavors.

PIONEER IN RESTORATIVE DENTISTRY

The Esthetic and Adhesive Approach

BY: DAVITA DANESH '19 & DANIEL KOHANCHI '19

Dr. Pascal Magne, an Associate Professor and the Don and Sybil Harrington Foundation Chair in Esthetic Dentistry at the Herman Ostrow School of Dentistry of USC, serves as the Director for USC's Dental Morphology, Function, and Esthetics (DMFE) module. Dr. Magne has had an illustrious career as a dental clinician, researcher, author, and professor in esthetic and adhesive dentistry. His accomplishments in the field of dentistry are remarkable and deserve recognition. Dr. Magne was asked to join as a faculty of the Herman Ostrow School of Dentistry of USC in 2004 and has since helped develop a profound restorative curriculum that embraces the advancements in restorative dentistry. His unique and genuine passion for his work is undeniably inspiring in each and every interaction.

Born in the small city of La Chaux-de-Fonds in Switzerland, Dr. Magne enjoyed the intricacies of technology and the arts. His admiration and respect for both his parents is apparent and has attributed to his success today. His mother, a watch-maker in the cradle of the watch-making industry, and his father, a prison-guard,

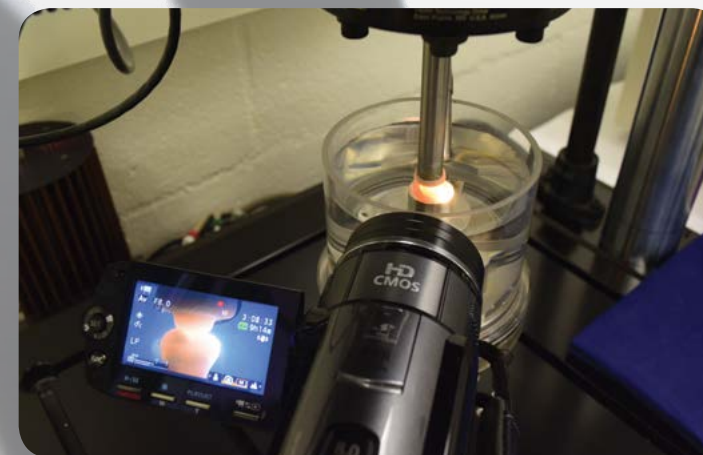
both taught him valuable lessons in life. His pursuit of greatness and drive for excellence are testaments to the values they instilled in him.

Dr. Magne's journey in the field of dentistry began when he spent several weeks shadowing his own dentist in a nearby city.

DR. MAGNE'S LOVE AND PASSION FOR WHAT HE DOES ARE CONTAGIOUS AND AS RESEARCH SIBLINGS WE GET TO BE PART OF INCREDIBLE PROJECTS AND LEARN FROM THE BEST MENTOR WE COULD ASK FOR.
- MEHRDAD RAZAGHY '20

Working with his hands and utilizing his creativity spoke directly to Dr. Magne's imagination. During this time, his brother, Michel Magne, worked for the same dentist. Today, Michel is a renowned master ceramist and expert in the art and science of esthetic dentistry. The two brothers continue to build on each other's strengths and creative spirits in the field.

Dr. Magne spent a majority of his academic years in Geneva, Switzerland, where he began his career as a skilled dental clinician and renowned researcher. Wanting to further his education in the field of dentistry, he decided to pursue a Ph.D. He owes much of his passion for luting procedures and adhesive dentistry to the years he spent on this educational path. In 2002, he released a book entitled *Bonded Porcelain Restorations in the Anterior Dentition*:



FATIGUE TEST OPERATIONS OF RESTORATIONS CARRIED OUT IN AN ARTIFICIAL MOUTH USING CLOSED-LOOP SERVOHYDRAULICS

A Biomimetic Approach. Today, this text has become one of the bibles of anterior cosmetic dentistry.

Dr. Magne's pursuit of research began in 1996 when he decided to focus on adhesive dentistry and biomimetics. He describes this idea of biomimetics as an approach to bonding that utilizes the best materials to mimic the natural tooth - a perfectly designed structure. Twenty years ago he began working with various types of ceramic, an excellent restorative material that has impeccable esthetics when utilized by a skilled clinician. He researched the benefits of ceramics in comparison to those of composite resin materials. Over the course of the last 20 years, materials have changed and so has Dr. Magne's research. He has learned to adapt along with this dynamic field of dentistry, and has encouraged the systematic evaluation of new technologies presented to dental professionals. Dr. Magne's research has made him an expert on the materials that are available for adhesive and esthetic dentistry. His most recent surge in research has been in composite resin materials and especially in the use of CAD/CAM technology, which he refers to as the "smartphone of the dentist" - a device that will be readily used by the next generation of clinicians.

Lately, Dr. Magne has focused his attention on determining how to optimize bonding by way of immediate dentin sealing (IDS). Dr. Magne expresses great pride in the success of utilizing the correct IDS technique. At USC, students are taught innovative and proven techniques thanks to Dr. Magne's pioneering research. He notes, "we promote a thick layer [of a superior material such as Optibond FL] to have a protected and completely polymerized bond." His research has evaluated the use of IDS in endodontically treated teeth, direct pulp capping and direct composite restorations. Moreover, the success of delayed IDS was studied and proven. Dr. Magne's findings were published in the *Journal of Prosthetic Dentistry*.

Dr. Magne conducts various studies with visiting scholars from all around the globe and is currently conducting research with Luciana Mara Soares. Together, their research is testing the difference in strength between large MOD inlays created by the Cerec CAD/CAM technology and those that are hand-crafted. Thus far, CAD/CAM designs have unsurprisingly proven their worth. Utilizing the IDS process in addition to the CAD/CAM system, it is now possible to create restorations that will not experience adhesive failures even at extremely high loads.

Dr. Magne's unique curiosity is contagious, and many colleagues have joined his team to continue igniting their spark of inspiration. When asked about what he believes lies in the future of restorative dentistry, he offered a solution that brings us back to the core of dentistry, the natural tooth. Dr. Magne believes that one day we will "capture the true essence of biomimetics by restoring teeth using real enamel and dentin [through stem cell production or through the utilization of extracted unrestored teeth]."

Dr. Magne's future lies in a continuing passion for research, educating young minds in the field of adhesive and esthetic dentistry, and continuing clinical work.



For the occupational therapy profession, 2017 is a truly special year. It was at a 1917 meeting in upstate New York that the profession was formally established by six individuals with the shared purpose “to study and advance curative occupations for invalids and convalescents.” The nationwide occupational therapy community joyfully celebrates this centennial anniversary milestone and reflects on a century rich with history, growth and impact.

2017 also marks the 75th anniversary of what is now known as the USC Chan Division of Occupational Science and Occupational Therapy. In 1942, USC began admitting students to courses in a new bachelor's degree program directed by renowned ceramic artist Glen Lukens and occupational therapy coordinator Mary L. Abbey, OTR within the College of Architecture and Fine Arts. With the country fully engaged in the Second World War, the *Los Angeles Times* noted that these Trojans would “do the many things occupational therapy makes possible for men who have suffered through service in war or industry.”

During the past 75 years, that single program has grown exponentially and evolved into the USC Chan Division, which has been proudly aligned with the Herman Ostrow School of Dentistry of USC since 2006. Today the division offers academic programs that educate hundreds of students from the undergraduate to postdoctoral levels, provides clinical services to tens of thousands of patients annually, and operates a research enterprise unrivaled by any similar educational program in the world.

Research at USC Chan is designed to systematize knowledge about “occupation” — defined as meaningful daily activities ranging from the ordinary to the extraordinary — and its influence upon health and well-being. USC Chan faculty members have collectively secured more than \$29 million of federal funding since 1994, and are internationally recognized for their excellence and innovation, sustained acquisition of extramural support and leadership in implementing interdisciplinary inquiry. Understanding “real people” in the context of their “real lives” requires conceptual and methodological expertise that has been, and continues to be, developed through scholarship in the fields of occupational science and occupational therapy. With more than \$9.6 million in current active grant funding, USC Chan faculty members are pursuing knowledge with relevant outcomes for real-world interventions that improve human health, quality of life and well-being.

The values and aims of this research mission are personified by Research Day 2017 keynote speaker Beth Pyatak, PhD, OTR/L,

CDE. Pyatak earned her PhD in occupational science from USC in 2010 and joined the faculty as an assistant professor in 2011. Her primary research interests lie at the intersection of chronic care management, occupational engagement and health and well-being among individuals with chronic illness and/or disability. She is also a registered and licensed occupational therapist and a Certified Diabetes Educator.

Pyatak is currently the Principal Investigator of a NIH-funded, three-year mentored career development award to pilot-test an innovative intervention, entitled *Resilient, Empowered, Active Living with Diabetes (REAL)*, which aims to improve the clinical and psychosocial well-being of underserved minority young adults with poorly-controlled diabetes (NIH #K01DK099202). Funded by the NIH/National Institute of Diabetes and Digestive and Kidney Diseases, this individually tailored, community-based intervention merges findings of an in-depth needs assessment, an evidence-based occupational therapy intervention framework (*Lifestyle Redesign*) and evidence-based diabetes self-management strategies. Pyatak's earlier proof-of-concept study demonstrated that the REAL intervention is feasible to implement, well-accepted by young adults with type 1 diabetes and type 2 diabetes, and has potential to produce positive changes in diabetes self-care and glycemic control.

The study randomized 81 young adults with diabetes to receive either the six-month REAL intervention or an attention control condition. Blinded data collectors evaluated glycemic control, diabetes self-care behaviors and quality of life outcomes, as well as potential intervention mediators, before and after the six-month intervention. Additionally, a rigorous process evaluation was employed to evaluate intervention implementation and study procedures. It is anticipated that findings from Pyatak's pilot study will be used to inform a large-scale randomized controlled trial of the REAL intervention as well as provide evidence of the effectiveness of occupational therapy services in chronic disease management.

Pyatak's project mentors include Anne Peters, MD, CDE, professor of clinical medicine at the Keck School of Medicine of USC and the director of the USC Clinical Diabetes Program; Donna Spruijt-Metz, PhD, research professor of psychology at the Dornsife College of Letters, Arts and Sciences and of preventive medicine at the Keck School and the director of the USC mHealth Collaboratory at the Dornsife Center for Economic and Social Research; and Robin Whittemore, PhD, APRN, FAAN, professor of nursing and the PhD program director at the Yale School of Nursing.

75 YEARS in OCCUPATIONAL THERAPY

By: MIKE McNULTY

Revealing the Secrets of Enamel

By: Aimi Nguyen '20 & Arian Barooty '20



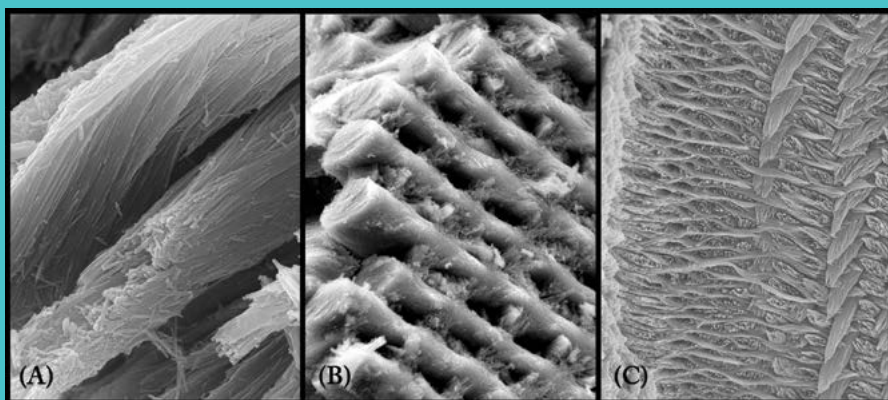
The metaphorical dominoes of life often have a peculiar way of falling into place. A native of Sydney, Australia, Dr. Michael Paine never anticipated that he would end up juggling roles in research, administration, and teaching at a university all the way in southern California. As a dental student at the University of Sydney, Dr. Paine had a natural gravitation towards the science courses in the curriculum, which led him to pursue a research position upon graduation. One of his mentors, however, strongly recommended that he become acquainted with the clinical aspects of dentistry before committing to a life of research, as the two paths offer considerably different experiences. Even though he enjoyed his one-year venture into clinical dentistry, Dr. Paine knew that research was what riveted him, and returned to the University of Sydney to pursue a Ph.D. in pathology with a focus on the biology of cancer.

When he arrived in America, Dr. Paine was on his way to St. Louis University to do postdoctoral research in pharmacology when he happened to meet Dr. Malcolm Snead, who was then an Associate Professor at the Herman Ostrow School of Dentistry of USC. Dr. Snead invited Dr. Paine to come to USC to join him in his research on enamel formation. That was in 1994 and the rest, as they say, is history. Fast-forward 22 years and Dr. Paine is currently a Professor at the dental school, Director of the Craniofacial Biology graduate program, and a leading scientist in the field of enamel research.

Much of Dr. Paine's work revolves around manipulating genes in mice that are crucial in enamel formation, whether it is knocking genes out, overexpressing them, or silencing them. What is fascinating about enamel-forming cells, or ameloblasts, is that they are the only epithelial cells in our bodies that produce mineralized tissues in non-pathological conditions. In addition, ameloblasts occupy a fairly unique space in cell biology because they are capable of transitioning from producing structural proteins, such as enamelin and amelogenin, to secreting ions, such as calcium and phosphate. Its only been within the last decade that

the mechanism behind this transition has been more thoroughly examined.

Perhaps the most direct clinical application of Dr. Paine's research on the structure and function of enamel has been a more thorough understanding of pathological processes such as those involved in amelogenesis imperfecta (AI). AI is a genetic disorder that affects 1 in 14,000 people in the United States every year. Patients suffering from AI may experience hypoplasia, hypocalcification or hypomaturization of the enamel, resulting in teeth that are thin, discolored, pitted, and readily chipped away. Ultimately, AI left unattended leaves teeth

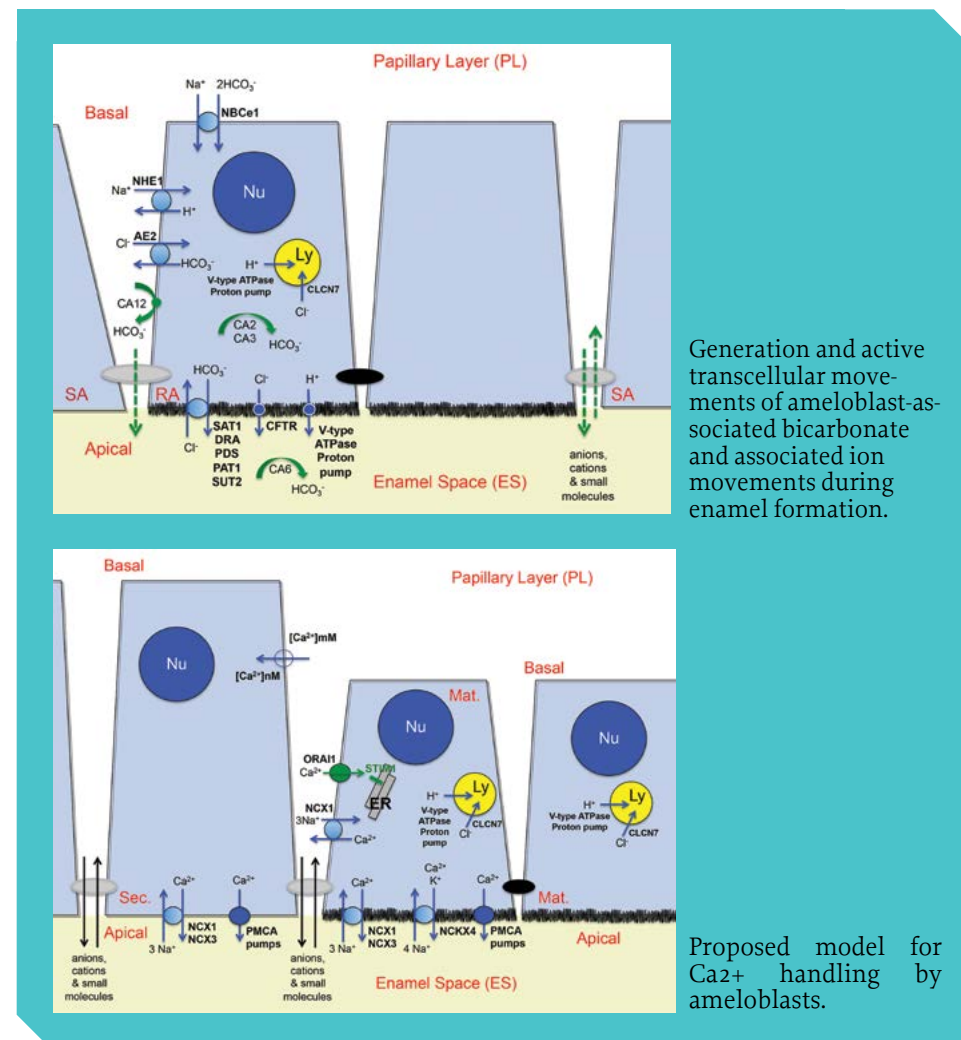


Electron microscopic images of a mouse lower incisor: (A) Enamel crystallites composing the enamel rod architecture. Two enamel rods are visible in the view. Approximate diameter of each rod is 5 micrometers. (B) Enamel rod-interrod (prismatic) architecture. Multiple rods can be visualized in the image. Approximate diameter of each rod is 5 micrometers. (C) Enamel rod-interrod (prismatic) architecture is evident in the bulk enamel on the right, while enamel rods change orientation and density as it reaches the surface enamel (left). Approximate diameter of each rod is 5 micrometers.

extremely susceptible to accelerated decay and infection. There are four types of AI, with different genetic causes. The mode of inheritance can be autosomal dominant, autosomal recessive, or X-linked, with each type weakening the enamel in a particular way.

Some of Dr. Paine's early research dealt specifically with ameloblastin, an enamel matrix protein (also known by the names amelin and sheathlin) encoded by the gene *Ambn*. By overexpressing *Ambn* in mice, Dr. Paine was able to provide in vivo evidence demonstrating that ameloblastin overexpression is linked to nanoscale malformation of enamel rods. This study provided promising links between ameloblastin and its role in enamel crystallite formation as well as in AI. The family of genes that governs the architecture of enamel crystals is a vast and sprawling one, and Dr. Paine has led research exploring the roles of various other members of this family, including dentin sialophosphoprotein (DSPP). DSPP codes for the expression of dentin sialoprotein (DSP) and dentin phosphoprotein (DPP) and is an important player in the creation of the region of enamel that coats the dentino-enamel junction. This region of enamel also happens to be tougher than the rest of the enamel surrounding it. While both DSP and DPP are essential for normal enamel formation, Dr. Paine found that overexpression of DSP in the enamel organs of mice resulted in significantly harder enamel while overexpression of DPP resulted in the development of more fragile and pitted enamel, which might have some promising implications for the protective properties of DSP.

More recently, Dr. Paine has studied the roles of ion channels and pH conditions in enamel production. The formation of hydroxyapatite crystals releases protons into the enamel environment, causing the space to rapidly become highly acidic. What is intriguing is the mechanism that the body uses to combat this sudden rise in acidity. Dr. Paine was particularly interested in a sodium-bicarbonate cotransporter, NBCe1, which resides in the dental epithelium and could potentially be responsible for neutralizing the acidity through the buffering action of bicarbonate ions. *SLC4A4* is the gene that codes for NBCe1, and mutations in this gene result in defects in the developing enamel. Dr. Paine found that mice with a null mutation developed extremely hypomineralized and thin enamel, with highly unorganized ameloblasts.



Currently there exists no definitive cure for patients suffering from AI. Patients can seek a range of treatment options, and the combination of both preventive and restorative measures are central to preserving tooth functionality. Treatment plans can include anything from sealants and bonding to full crowns and implants. Often the comprehensive treatment of a patient with AI can involve the integrated efforts of multiple dental specialties, including general and pediatric dentistry, prosthodontics, orthodontics, and oral surgery. Hopefully, further research in the field of enamel formation will ultimately lead to even more effective forms of care in serving patients with AI.

When he is not involved with research, Dr. Paine gives lectures to Ph.D. and Master's degree students and guides second- and third-year dental students in problem-based learning sessions. Furthermore, Dr. Paine's work makes innovation and research in the Craniofacial Biology program at USC possible, as he has a vital role in procuring funding for doctoral and

postdoctoral students conducting studies in oral and craniofacial health. In 2011, Dr. Paine was a recipient of the prestigious T90/R90 training grant offered by the National Institute for Dental and Craniofacial Research. The grant provided \$2 million to support students in their research over a five-year time span, and Dr. Paine has recently received renewed support to cover the next five years. Such grants demand incredible investments of time and energy, from preparing the proposal to continued administration and reporting of progress throughout the period of support, and Dr. Paine spent 6-8 months working on his most recent submission. For Dr. Paine, it is about more than just being able to finance studies in oral health. He states, "I don't just want to fund research on dental problems, I want to be involved with training the next generation of scientists to meet the needs of the dental community." Dr. Paine was recently named a Fellow of the American Association for the Advancement of Science (AAAS) in recognition of his tremendous contributions to the arena of enamel research.

A Journey Towards Biomimetic Dentistry

BY: AMNA IRMAN '18 & MONIKA KUNDER '18

Dr. Jin-Ho Phark, an Assistant Professor of Clinical Dentistry at the Herman Ostrow School of Dentistry of USC, graduated with a DDS degree from Charité, Humboldt University in Berlin, Germany in 2003. He engaged in clinical investigations studying the periodontium, specifically the gingival architecture in pediatric patients. Following graduation, he continued to work at the dental school as a faculty member and a researcher, while also working in private practice. During this time, he conducted research including a clinical comparative study of over-the-counter, in-home teeth bleaching products and dental restorative materials.

Dr. Phark's journey in the United States began when he was offered a faculty position at Case Western Reserve University (CWRU) in Cleveland, Ohio. He worked at CWRU as a full-time faculty member for four years, teaching comprehensive dental care to students. He trained students to work with various types of restorative materials, as well as to design and deliver removable dental prostheses and appliances. While teaching at CWRU, Dr. Phark was also involved with research and treating patients on the clinic floor.

In 2010, Dr. Phark joined the Herman Ostrow School of Dentistry of USC Division of Restorative Sciences as a full-time faculty member. At USC, Dr. Phark

teaches dental students and residents in advanced programs both didactic and clinical dentistry mainly pertaining to dental materials, computer-aided design and computer-aided manufacturing dentistry, and cariology.

Dr. Phark's research at USC emphasizes dental biomaterials used in restorative dentistry, such as adhesives, composites, ceramics, cements, and implants. Dr. Phark and his team study the mechanical properties of restorative materials as well as their interactions and bonds with different materials and tissues. The results of these studies help the researchers determine the most efficient way to use these materials in clinical situations. Currently, Dr. Phark is working with his residents to develop adhesives with an antibiotic component to prevent the development of recurrent caries.

The aging of restorative materials is also a topic of interest for Dr. Phark. He and his team investigate the longevity of materials once they have been bonded. Unfortunately, it is very difficult to follow up with patients years after treatment. Therefore, the researchers utilize artificial aging methods for their studies by placing bonded restorations into a thermal cycler that mimics the temperature changes in the mouth. During this artificial aging process, there is a change in temperature on the surfaces of the mate-

rials as well as fluctuation between expansion and compression within the materials. These compression and expansion forces might have an effect on the adhesive interface resulting in micro-leakage and premature debonding. This ultimately can lead to the detachment and failure of the restoration as well as patient sensitivity. This study helps to evaluate the durability of restorative materials and in doing so, sheds light on each step in the breakdown process and how it can be prevented.

Dr. Phark is also involved in research that is looking into overcoming polymerization shrinkage as well as the hardening behavior of composite after the polymerization process. His study emphasizes the importance of the complete hardening of composite shortly after polymerization.

Another project Dr. Phark is working on is testing the bond strength between dentin and silver diamine fluoride (SDF), a

solution that can help arrest active caries. SDF is non-invasive and can help patients who are not able to be treated frequently in a proper dental setting, such as elderly and pediatric patients. Recently, Dr. Phark and his team have been using SDF on pediatric and special patients, and it has proven to do a remarkable job in arresting caries when supported by adequate oral hygiene. Dr. Phark sees the future of restorative dentistry as moving towards biomimetic

and conservative approaches. He and his colleagues are looking into resin infiltrations to seal non-cavitated carious lesions noninvasively through the formation of a barrier that prevents the progression of caries.

As an educator and researcher, Dr. Phark has been awarded the International Association for Dental Research's Arthur Frechette Award in 2009 and was named one

of ten professors changing dental technology in 2015 by Medical Technology School.

When giving advice to his students, Dr. Phark urges them to "always stay curious and try to understand what you do and why you do a particular step." He believes this is the driving force towards learning and in continuing to push the boundaries of dentistry.

Finley, Fisher Awarded \$450K Grant to Develop *VR-based System for* Walking Rehabilitation

By: John Hobbs MA'14

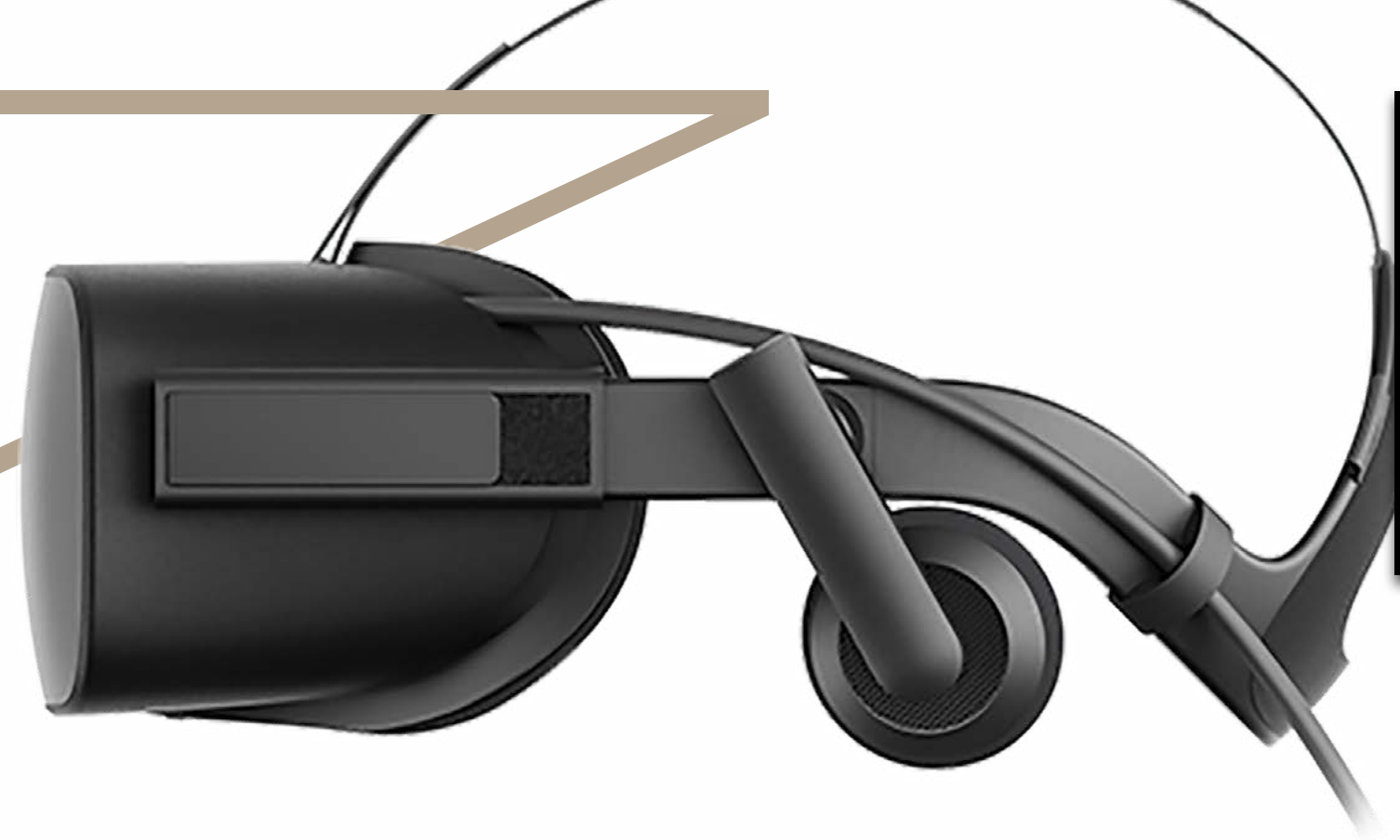


A trip to the physical therapist could soon feel a bit more like a trip to the arcade, thanks to a new multidisciplinary study being conducted at USC.

James Finley and Beth Fisher of the USC Division of Biokinesiology and Physical Therapy and Marientina Gotsis of the USC School of Cinematic Arts have received a two-year grant from the National Institutes of Health to develop and test a virtual reality (VR)-based program for walking rehabilitation in patients with Parkinson's disease.

Symptoms such as stiffness, shaking and balance problems can cause people with the degenerative brain disorder to have difficulty walking. Traditional physical therapies have centered around strength training, stretching and movement practice, but it was recently discovered that those strategies may not lead to long-term motor learning by themselves.

"From a motor-learning perspective, we now know that learning and long-term retention are optimized when the patients have a focus on the movement's effect on the environment such as 'step over the obstacle' rather than on performing the movement itself — 'flex your hip,'" explained Fisher, professor of clinical physical therapy and director of the Neuroplasticity and Imaging Laboratory.



ON YOUR FEET

The proposed VR-based system would get individuals with Parkinson's back on their feet, practicing the actual walking skills necessary to navigate their communities — with seemingly real-world feedback — all while under the watchful eye of a physical therapist.

"We will be designing a system that will allow patients to experience and practice challenging tasks like negotiating obstacles, walking through crowds, doing turns and walking over thresholds to represent the challenges they would experience in the physical world," said Finley, assistant professor and director of the Locomotor Control Laboratory.

A typical treatment session would involve a patient wearing a VR headset and walking on a standard or omnidirectional treadmill or over the ground to improve their walking ability in a way that feels more like playing a video game.

"With motor rehabilitation, one of the things patients need is lots of repetition," Finley said. "One of the advantages of doing something like a game is it helps increase motivation to undergo the amount of practice necessary for skill learning."

During the study's first phase, the researchers will be designing prototypes of a low-cost, portable gait-training system that can be set up and easily used in the physical therapy office.

"Clinicians have a very limited time with their patients so any hurdles or barriers that are introduced by technology can limit the actual use of that technology in the clinic," Finley said.

The researchers will then recruit clinicians and their patients to use the system, offering feedback to improve the experience for both the user and the supervising physical therapist.

INTO THE VIRTUAL WORLD

Gotsis and her team of researchers at the USC Creative Media and Behavioral Health Center will design and assess the VR experience — paying close attention to the tiniest of nuances, including sound and haptic feedback — to ensure the most life-like simulations.

"We would like to create a pleasurable, safe and challenging walking virtual reality experience," Gotsis said. "We will know from participant input if the experience is enjoyable, and our collaborators will help us understand

whether the experience is challenging enough to promote neuroplasticity."

Patients will have the choice of different environments, including a cityscape with high rises, a seaside pier with a Ferris wheel, a path in a park or a visit to Trader Joe's. To be most effective, users should choose environments that reflect the challenges they most often face in the real world, Finley said.

The study's second phase will involve assessing the treatment strategy's effectiveness on actual patients. Using the developed environments, patients with Parkinson's will complete a set of progressive training sessions while researchers determine the program's efficacy.

"When it comes to imagining the future of health care, we cannot afford to leave it all to the imagination of a single expert group," said Gotsis, referring to the power of multidisciplinary approaches to solve some of society's most vexing problems. "Nobody knows best. We're all stakeholders in creating new therapies whether they use virtual reality or paper clips and glue."

Research was supported by the Eunice Kennedy Shriver National Institute of Child Health and Human Development of the National Institutes of Health (award number R21HD088342).

Our Digital Era of Dental Science

By: Susan Park '19 & Kerry Cheng '19



A Korean native, Dr. Jenny Jin Son came to Southern California at the age of nine. After she studied engineering as an undergraduate, she entered a Ph.D. program for chemical engineering. However, two years into the program, she realized a career in engineering was not the path she wanted to take. Instead she received a master's degree, finished her graduate studies, applied to dental schools, and in 2006 was accepted into the Herman Ostrow School of Dentistry of USC. Upon graduation, Dr. Son immediately enrolled in the school's advanced prosthodontics residency program. This specialty appealed to her because of the comprehensive learning it encouraged, starting with treatment planning and culminating with the completion of the dental treatment. Inspired by her time as a teaching assistant in the pre-doctorate prosthodontics courses and after enjoying interacting with and helping dental students, Dr. Son decided she wanted to pursue a career as teacher. Once she completed the advanced prosthodontics program in 2014, she was hired by USC as a full-time faculty member.

The research project Dr. Son took on when she joined the faculty at USC investigates the fit of all-ceramic restorations fabricated by computer aided design and computer aided manufacturing (CAD/CAM) technology on stock abutments, in conjunction with Dr. Winston Chee and Dr. Richard Lin. "The accuracy of scan, the fit of the milled restoration to a stock abutment, and the ease of manufacturing are the key factors we are looking into. There are many different systems out there and we want to design and test the machinable ceramic restorations for

not only accuracy and strength, but also for what would work in a school environment," says Dr. Son. In addition, Dr. Son is designing different anti-rotational features in the abutments and is studying how they affect the fit between the abutment and the crown. One distinct advantage of CAD/CAM technology is its reproducibility, with an added advantage of being fabricated in-house. Currently, 3-D printing technology is also being explored in terms of provisional restorations. Further research explores what is to be done if a certain implant restorative system is unavailable for fabricating the restoration.

Clinical changes likely will stem from Dr. Son's research in implants within the next 5 to 10 years. There have been many recent advances in restorative material choices for implants. New materials and

new technologies are available to implement these changes. While USC is traditionally known for gold crowns, students are now more exposed to all-ceramic types of restorations, following current trends and advances in dentistry. Both stock and custom abutments can be used to deliver these restorations, and Dr. Son's research will aid in manufacturing them with predictability and accuracy. If the research is successful and is clinically applicable, CAD/CAM technology could potentially restore implants that would otherwise require a labor-intensive and technologically challenging workflow.

Dr. Son is also involved with research on guided surgery for implants. Guided surgery uses information from the CT scan of a patient, combined with an intraoral scan, to make a surgical stent that is fabricated



"Dr. Son is extremely knowledgeable about the CAD/CAM scanning and milling machines. She is critical to the students' learning of the newest, state-of-the-art technology at USC."

Rebecca Yamane '19

via CAD/CAM technology by milling or by 3-D printing. In Dr. Son's research, the accuracy of the fit and digital scans, as well as their compatibility with different software, will be measured. This innovative technique has already been implemented in the pre-doctoral implant clinic under the direction of Dr. George Cho, and in the course of this study, many more patients will be able to take advantage of this cutting-edge procedure as the researchers assess the accuracy of different guides.

"I'm also involved with research at Keck Medical Center," Dr. Son adds. "They're testing the safety and effectiveness of a medicine on patients with troublesome sialorrhea, involving patients with Parkinson's disease, stroke, traumatic brain injury, or sialorrhea secondary to oral cancer or medications. For patients with sialorrhea, there is an increased risk for inhaling saliva, food, or fluids into the lungs. Also, skin complications around the mouth, bacterial infection, bad odor, dehydration, and social stigmatization may be problematic for these patients. They are testing medication to stop this, and I'm a subinvestigator as a dentist conducting dental examinations and giving recommendations." The study is a clinical trial, and the screening phase began in October 2016. Once patients are approved for this clinical trial, they will return to USC about four times a year for a follow-up to assess the oral effects of the medication. Dr. Son notes that one of the differences between interdisciplinary research at Keck and targeted research in dentistry is the applicability and the reality of studying oral health as part of the entire human body. Dentistry is not only about teeth, it is about our health, and research can help a greater number of people, rather than treating just "one tooth at a time."

"We get to see patients with a variety of systemic medical conditions that make it difficult for them to receive dental treatment," she explains. Saliva-related research has been conducted in areas such as bacterial detection and its relationship with decay, periodontal disease, and general oral health. Collecting a saliva sample for bacterial load or protein can be as easy as a swab, making saliva a useful medium for study.

Dr. Son spends time teaching and working in the pre-doctoral clinic, the advanced prosthodontics clinic, and the advanced operative clinic. In the pre-doctoral clinic, she is primarily responsible for CAD/CAM restorations and implants.

She perceives that the main difference between teaching pre-doctoral students and post-graduate students is that the latter are already dentists who are pursuing further education in order to become experts in treating complex cases, and to become leaders, educators, and to engage in other opportunities in their dental career. "When I teach [pre-doctoral] students, I try to remember back to the time when I was a dental student, and I try to go step by step, one by one. With advanced graduate students, we follow standard protocols, but it might be at a more complicated level, and I have more expectations for them to apply their knowledge and skills to come up with creative and innovative solutions."

Dr. Jenny Jin Son is a distinguished alumnus and educator at Herman Ostrow School of Dentistry of USC whose current research will improve the ease of manufacturing and delivery of implant restorations, as well as improve the oral health of those with sialorrhea.



PAVING THE WAY IN ONCOLOGIC RESEARCH

BY: NATALIE INOUE '18 & KRISTA PRIMLEY '18

Even as an undergraduate student at California State University, San Jose, Dr. Jiang Zhong had a passion for molecular biology. "I've always been interested in how a cell functions, and how a cell decides to grow, divide, and differentiate," he states. After receiving his master's degree in 2002 and his Ph.D. in 2003 in molecular biology and biochemistry, he began pursuing research at USC and is currently an Assistant Professor with his own laboratory at the Herman Ostrow School of Dentistry. His research focuses on gene expression and regulation through stem cell differentiation, the molecular characterization of circulating tumor cells, and the molecular foundation of treatment resistance in neuroblastoma.

As a well-published scholar, Dr. Zhong's most recent publications have opened up a new world of opportunities for interdisciplinary research and biomedical technology. His research involves innovative microfluidic processors, allowing for simultaneous profiling of multiple single cells. The basis of Dr. Zhong's research is the notion that looking at single cells in this way allows researchers and clinicians to spot rare cells, such as circulating tumor cells responsible for cancer metastases, that can easily be missed when a pool of heterogeneous cells are analyzed all together as a population-averaged lysate.

Single-cell molecular profiling also allows for precise studies in gene regulation. In 2015, Dr. Zhong found that changes in tissue elasticity affect cells' gene expression. Cells behave differently and express various genes at different levels in the many microenvironments found in the human body, which can be mimicked in vitro through manipulating the cell culture media.

In another study, Dr. Zhong was able to identify a singling protein that promotes cell differentiation, which revealed a new means of controlling adipogenesis in bone marrow stem cells. In turn, this may have great significance for the structural and functional recovery of the hematopoietic microenvironment after injury due to radiation treatments for cancer and other diseases. He took this a step further and investigated new approaches for targeting the leukemia microenvironment, since current treatments for leukemia are very toxic to the patient and cannot differentiate between cancerous cells and healthy cells. By targeting intercellular communication between leukemia cells and bone marrow stem cells, healthcare professionals can improve clinical outcomes in combination with standard therapy.

His most recent review states "the influence of mesenchymal stem cells (MSCs) and the tumor microenvironment (TME) is now widely appreciated in cancer. However, distinct MSCs in the TME can come from

different origins and exhibit a diversity of anticancer properties. Recently, increasing clinical trials have been performed to study the anticancer properties of MSCs." In addition to their primary effects, MSCs could be employed as carriers of multiple anticancer agents as they can track microscopic tumors and pathological lesions without incurring the risk of spreading tumor cells. Through projects like Dr. Zhong's, MSCs could eventually be seen as a new clinical paradigm in anticancer therapies.

Ultimately, Dr. Zhong hopes his research on circulating tumor cells will reinvent diagnosis in oncology. Although right now cancer diagnosis is typically conducted through morphologic interpretation, his goal is to shift this standard of practice towards molecular

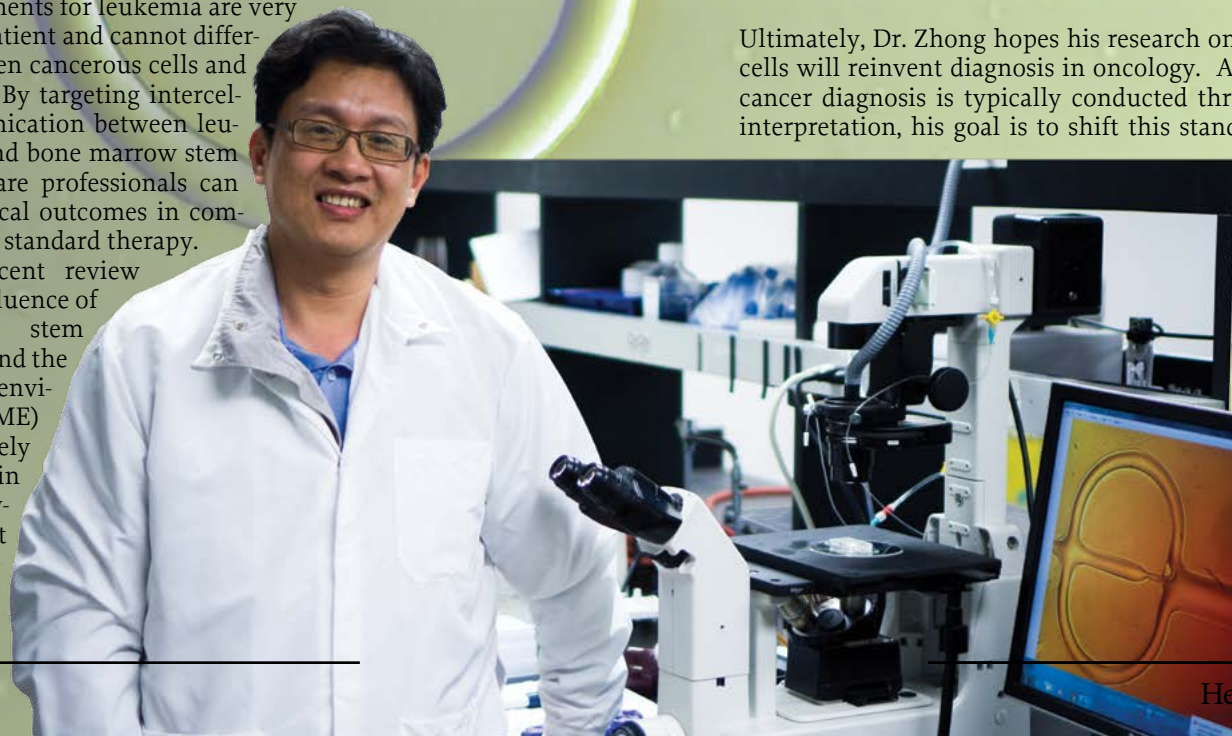
characteristics. Not only would understanding the physiologic features of cancer cells allow doctors to tailor their treatments specific to the responses of tumor cells, but it would also provide practitioners with a prognostic marker.

An example Dr. Zhong gives of inefficient diagnosis is in breast cancer and its metastasis to the brain. "When you find [cancer cells] in the breast you call it breast cancer, and when you find it in the later stage in the brain, you call it a brain tumor," he explains. "Right now, they are being treated by two different doctors even though cell molecularly they may be the same. If we can go into molecular classification of cancer, not only could we have a more precise diagnosis, we will also have more target drugs to be able to treat patients with."

Another research topic paving the way in oncologic diagnosis is Dr. Zhong's research in using saliva to detect oral cancer. Because the oral cavity is easily accessible and providing salivary samples is much less invasive than blood sampling, the opportunities for early detection in cancer diagnosis could be endless. With such a diverse population of microorganisms and considering its role as a "gatekeeper" for the body, the oral cavity could provide a new, more efficient method for detection.

In addition to conducting research, Dr. Zhong teaches DDS students at the Herman Ostrow School of Dentistry of USC. When asked why he decided to teach problem-based learning classes, he states, "Teaching is a duty. It is not just about knowing how things work, but you want the society to understand why it is important."

From his ground-breaking research to his outlook on teaching, Dr. Zhong is paving the way for the next generation of healthcare professionals. And it is through these accomplishments that he hopes to make an impact on society.



RESEARCH DAY

APRIL 5, 2017

SCHEDULE OF EVENTS

08:00 am

09:00 am – 12:00 pm

11:30 am – 12:00 pm

11:30 pm – 12:30 pm

12:30 pm – 12:45 pm

Registration (Presenters and Judges)

Poster Presentations Judging

General Registration

Lunch

Opening Remarks

Randolph Hall, PhD

Vice President of Research

University of Southern California

Avishai Sadan, DMD, MBA

Dean

Herman Ostrow School of Dentistry of USC

Yang Chai, DDS, PhD

Associate Dean of Research

Herman Ostrow School of Dentistry of USC

12:45 pm – 01:25 pm

Keynote Speaker

John D.B. Featherstone, MSc, PhD

“The Evidence for Caries Management by Risk Assessment (CAMBRA®)”

University of California, San Francisco

01:30 pm – 02:10 pm

Keynote Speaker

Mark Urata, MD, DDS

“Craniofacial Surgery: Innovation Leading to Better Answers”

Keck School of Medicine

Herman Ostrow School of Dentistry of USC

Children’s Hospital Los Angeles

02:15 pm – 02:55 pm

Keynote Speaker

Beth Pyatak, PhD, OTR/LM, CDE

“It makes you feel like there’s hope: Insights and findings from the Resilient, Empowered, Active Living (REAL) Diabetes Study”

Chan Division of Occupational Science and

Occupational Therapy at USC

03:05 pm – 04:00 pm

03:05 pm – 05:30 pm

04:00 pm – 04:30 pm

04:30 pm – 05:30 pm

05:00 pm

Poster Viewing

Vendor Fair in Hall of Fame South

Award Presentations

Reception

Vendor Fair Raffle



JOHN D.B. FEATHERSTONE, MSC, PHD

UNIVERSITY OF CALIFORNIA SAN FRANCISCO

Dr. John Featherstone is Dean of the School of Dentistry at the University of California, San Francisco (UCSF) and Distinguished Professor of Preventive and Restorative Dental Sciences. He holds a Ph.D. in chemistry from the University of Wellington (New Zealand). His research over the past 43 years has covered several aspects of cariology (study of tooth decay), and he was a pioneer in research on laser interactions with hard tissues. He is currently active in implementing caries management by risk assessment in several dental schools across the world. He has received numerous national and international awards, including the Norton Ross Award for excellence in clinical research from the American Dental Association (2007). He is an Honorary Fellow of the American College of Dentists, and the Pierre Fouchard Society, an honorary lifetime member of the Academy of Laser Dentistry and also the American Dental Association. He has published over 295 papers and book chapters.

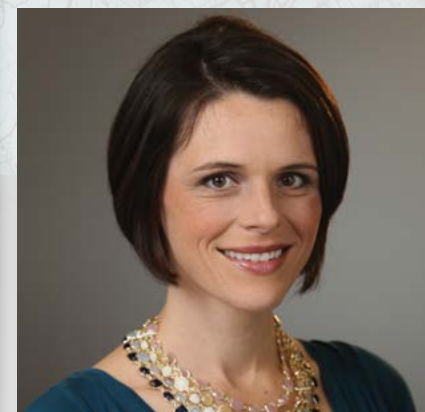


MARK URATA, MD, DDS

CHILDREN’S HOSPITAL LOS ANGELES, KECK SCHOOL OF MEDICINE, HERMAN OSTROW SCHOOL OF DENTISTRY OF USC

Dr. Mark Urata is a Professor and Division Head of Plastic and Maxillofacial Surgery at Children’s Hospital of Los Angeles, Chair and Chief of the Division of Plastic and Reconstructive Surgery at the Keck School of Medicine and Chair of the Division of Oral and Maxillofacial Surgery at the Herman Ostrow School of Dentistry of the University of Southern California. He is a board certified craniofacial surgeon. Dr. Urata trained for 18 years following his undergraduate education. He received his dental degree from the USC School of Dentistry and his medical degree from the USC Keck School of Medicine. He completed a residency in oral and

maxillofacial surgery before matriculating to general surgery and then completing a residency in plastic and reconstructive surgery at USC. He then moved across town where he completed a fellowship in craniofacial surgery at the University of California, Los Angeles. Dr. Urata has authored numerous scientific articles and book chapters and has been voted amongst the nation’s top surgeons according to multiple sources including U.S. News and World Report, Best Doctors and America’s Best Plastic Surgeons.



BETH PYATAK, PHD, OTR/LM, CDE

HERMAN OSTROW SCHOOL OF DENTISTRY OF USC

Dr. Beth Pyatak is an occupational therapist and certified diabetes educator with a faculty appointment in the Chan Division of Occupational Science and Occupational Therapy at USC. As an assistant professor at USC, she has been involved in several research projects that aim to understand the everyday challenges of living with diabetes, and develop strategies to help people more effectively manage their diabetes and enhance their quality of life. In particular, her work has focused on meeting the needs of medically underserved populations who experience health inequities. Currently, she is leading an NIH/NIDDK funded study to evaluate the Resilient, Empowered, Active Living or REAL Diabetes intervention, developed by Dr. Pyatak and her colleagues. She is involved in advocacy efforts with the American Diabetes Association, serves on the advisory council for the Los Angeles Diabetes Care Network, and is passionate about helping people with diabetes and other chronic conditions live their lives to the fullest.

KEYNOTE SPEAKERS

POSTER CATEGORY AWARDS

- Advanced Specialty Program Resident
- Biokinesiology and Physical Therapy Candidate
- Biokinesiology and Physical Therapy Student
- Dental Hygiene Student
- Graduate Post-doctoral Trainee
- Graduate Pre-doctoral Candidate
- Occupational Science and Occupational Therapy Student
- DDS Student – Basic Science
- DDS Student – Clinical Science
- Dean's Research Award – Awarded to the most outstanding project poster

J.A. WILSON DENTAL LIBRARY BIOINFORMATICS AWARD

The "JA Wilson Dental Library Bioinformatics Award" will be presented to the best poster or demonstration of research incorporating a bioinformatics approach. Judges will consist of the information specialist from the Wilson Dental Library, a representative of the Bioinformatics Services Program of the Health Sciences Libraries and a faculty representative of Ostrow School of Dentistry. The competition is open to any graduate student or young researcher who utilized bioinformatics tools for statistical and functional analysis of high-throughput 'omics data, especially the bioinformatics software provided by the Health Sciences Libraries. The candidate must be enrolled at the Herman Ostrow School of Dentistry at the time of submission and research completed at USC with a USC Faculty Advisor. Faculty are not eligible. The awardee will be presented with a certificate and gift card.

USC STEVENS CENTER FOR INNOVATION AWARDS

"Most Disruptive" (Innovative) and "Best Commercial Potential"

Awarded to the posters with the highest likelihood of transferring into practical use. The USC Stevens Center for Innovation is a university-wide resource for USC innovators in the Office of the Provost. Designed to harness and advance the creative thinking and breakthrough research at USC for societal impact beyond traditional academic means, they focus on the licensing of technologies, expanding industry collaborations and supporting start-ups. Their mission is to maximize the translation of USC research into products to public benefit through licenses, collaborations and the promotion of entrepreneurship and innovation.

INNOVATIVE SCIENTIFIC ACHIEVEMENT AWARD

The award was created to honor Herman Ostrow School of Dentistry students, researchers and post-doctoral fellows who have authored articles published in prestigious scientific publications. The purpose of the award is to recognize extremely talented and promising researchers early in their academic careers who help our school and USC move towards an undisputed elite status in research and academics.

RESEARCH DAY

POSTER ABSTRACTS

FACULTY

Poster #: 1

Title: Correlation between condensed PBL sessions and NBDE Part I
Name: Nasrin Bahari Chopiuk

Background: Problem based learning is used to teach students to critically assess clinical cases rather than have the students memorize various biomedical facts. The facilitators role is not to lecture, but to guide the students in solving complex problems. National Board of Dental Education Part 1 tests the dental students' knowledge of the biomedical sciences. Thus, to determine whether facilitator hours of interaction with students affects the NDBE Part 1 outcome, we used the results of the examination as our external metric. **Purpose:** In this study we aimed to determine whether a change in Problem Based Learning instructional hours (9 facilitated hours/week to 6 facilitated hours/week) had an impact on students' first-attempt passing rate of the National Board Dental Examination Part 1. The change in facilitated hours is allocated to independent learning time. **Methods:** Data for Ostrow School of Dentistry of USC first-attempt pass rates were extracted from the Academic Affairs database. The mean was calculated over a 5-year period from 2007-2011 reflecting 9 hours/week-facilitated instructions and 5-year period from 2012-2016 reflecting 6 hours/week-facilitated instructions. **Results:** Figure 1 displays the total number of students used in this correlation study, where (n=670) for 3 sessions/week facilitated biomedical sciences vs. 2 sessions/week facilitated (n=659) plus additional time for independent study time in biomedical sciences. Figure 2 represents an average of 92% passing rate (3 days sessions/

week) for first-attempt NBDE Part 1 vs. an average of 94.5% passing rate (2 days sessions/week plus additional day for independent study time) for first-attempt NBDE Part 1. We found no significant difference, $P > 0.5$. **Conclusion:** Herein, we provide evidence for the first time that condensed biomedical instructional hours/week had no impact on the DDS students National Board Dental Examination Part 1 passing rate ($P > 0.5$).

Poster #: 2

Title: Kinematic analyses of the TMJ during functional movements and joint mobilization
Name: Sally Ho

Background: Joint mobilization has been employed for managing TMD. No existing literature has analyzed the biomechanical characteristics of TMJ mobilizations. The current study may offer some evidence for the effectiveness of TMJ mobilization and serves as a prelude to further clinical research. **Purpose:** The purpose of this cadaveric study is to investigate the kinematics of the TMJ during functional movements and during TMJ mobilization. **Methods:** We used nine fresh cadaveric head specimens and mounted each on a test frame with a 6-axis load cell. A 6 camera Vicon Motion Analysis System and a pair of triplets of retroreflective markers were used to track movement of the TMJ. Functional movements (jaw opening/closing, protrusion, retrusion and lateral deviations) were performed passively by a TMD physical therapist. Five mobilization procedures (unilateral inferior glide with anteromedial translation, bilateral inferior glide with anterior translation, inferior glide with posterior translation followed by anterior translation, inferior glide with anterior rotation followed by anterior translation, and lateral glide) were then performed. Jaw opening was tested again at the end of the

experiment. **Results:** 1. During jaw opening, the condylar head rotates anteriorly and translates anteriorly as described by the biomechanical principles. 2. There were significant increase of condylar rotation, anterior translation and inferior translation between pre- and post-test jaw opening. 3. Both unilateral and bilateral inferior glide plus anterior translation produced greater displacement in anterior and inferior directions, as compared to adding anterior/posterior rotation during mobilization. **Conclusion:** Unilateral and bilateral inferior glide with anterior translation can be applied to patients if anterior or inferior movement is limited as in the case of limited jaw opening; addition of rotational movement reduced translations in both anterior and inferior directions. Next step: use real human subjects to study the efficacy of TMJ mobilization.

Poster #: 3

Title: Interprofessional Geriatric Assessment Program: filling in the "GAP"
Name: Lisa Hou

Background: The Geriatric Assessment Program (GAP) at Keck Medical Center of USC is for adults over the age of 65 who have multiple medical issues and memory loss. Given the complexity of health conditions and social circumstances of the patients served by the GAP team, we hypothesized that the patients may have a high prevalence of physical therapy, occupational therapy, and/or dentistry needs. **Purpose:** To identify the dentistry, occupational therapy, and physical therapy needs of the patients referred to the GAP clinic. **Methods:** 68 patients were seen at the GAP clinic from Dec 2015 – Jan 2017. Referral sources included: medicine (54.4%), social services/social work (16.2%), physical therapy (14.7%), self (10.3%), psychology (2.9%), and pharmacy (1.5%). Patients are

seen by a team of specialists from dentistry, medicine, occupational therapy, pharmacy, physical therapy, psychology, and social work, who all have advanced training in care for older adults. Once the GAP assessment is completed, the patients return for a family conference to learn the findings and recommendations from the GAP team. **Results:** Patient demographics were as follows: average age 80.8 (SD 8.8). 65% female, 55% male. 48.5% Caucasian; 20.6% Hispanic; 14.7% African American; 16.2% Asian/Pacific Islander. **Conclusion:** Patients in the GAP clinic had dentistry, occupational therapy, and/or physical therapy needs that included dental emergencies, home modifications, and continuation of outpatient rehabilitation services. A comprehensive inter-disciplinary program for at-risk older adults, such as the GAP clinic, may be an effective way to ensure that older adults are aware of the comprehensive health services available and receive the appropriate referrals to providers.

Poster #: 4

Title: Building successful research and clinical collaborations: strategies for stakeholder engagement
Name: Jenny Martinez

Background: Stakeholder engagement (SE) has been suggested as an effective approach for ensuring the development of patient-centered, relevant, usable, and transferrable interventions and strategies for real-life scenarios, thereby accelerating the knowledge-to-practice translation and improving patient outcomes. To this end, engaging healthcare stakeholders (i.e., patients, caregivers, clinicians, payers, policy makers) throughout the research process has emerged as a focus for national initiatives and a federal funding priority. However, there is limited discussion regarding strategies for SE within post-

acute care rehabilitation. **Purpose:** To present a conceptual model for meaningful stakeholder engagement in rehabilitation research. **Methods:** A literature review of current evidence was conducted to inform the development of a conceptual model for SE for rehabilitation research. **Results:** The following four domains were identified: partnering with key stakeholders early in the project development process, maintaining two-way communication throughout implementation, collaborative problem solving, and incorporation of reciprocal co-learning opportunities. Through application of this framework, we identified six key stakeholder groups for post-acute care: patients and caregivers, providers, purchasers, payers, policy makers, and the research investigators. Further, we identified strategies for meaningfully engaging each stakeholder group within each domain. **Conclusion:** This conceptual model for SE in rehabilitation can be used to develop collaborative research programs that are timely and responsive to stakeholder priorities, decreasing the research-to-practice gap and enhancing patient outcomes. Future research is needed to further examine SE in action and strategies to overcome barriers to meaningful engagement.



Poster #: 5

Title: Identifying risk of upper extremity injuries in dental hygiene professionals
Name: Diane Melrose

Background: Given the amount of time using scaling instruments, dental hygienists are prone to developing repetitive strain injuries of the arm, wrist, and hand. As a result, work-related musculoskeletal disorders affect dental hygienists at a high rate. **Purpose:** To establish a predictive model for development of pathologies in dental hygienists.

Methods: This longitudinal study is a collaboration among USC dental hygiene (DH) and occupational therapy (OT) and DH at Loma Linda University. Recruitment targets are 120 DH students (exposed to high-intensity hand activities) and 60 OT students (non-exposed control). Repeated collection of measures occurs every semester across the two-year program, including: morphology of anatomical structures using sonographic imaging; neurophysiologic function using nerve conduction testing; symptoms and function using multiple questionnaires; and task exposure to extracurricular activities and from patient visit logs and video analyses of hand tasks in the clinic. **Results:** To date, DH (n=53) and OT (n=55) students are similar in age (DH, 24.4 yrs., SD=3.5 yrs.; OT, 24.8 yrs., SD=2.6 yrs.) and are primarily right handed (92.5%, 87.3%) females (88.7%, 89.1%). The groups have equivalent grip/pinch strengths, report similar extracurricular activities, and essentially no pain or limitations. A feasible process for video collection in the clinic has been established and a coding process for descriptive characteristics has been validated. **Conclusion:** Students entering both programs have essentially no pain or limitations, nor any diagnostic indicators of pathology. Baseline group equivalency ensures that changes in outcome measures can be evaluated as related to differences in task exposures.

Poster #: 6

Title: Health and well-being of late middle-aged, rural-dwelling Hispanics with arthritis
Name: Stacey Schepens Niemiec

Background: Hispanic older adults with arthritis are at high risk for arthritis-related limitations in daily activities. Moreover, rural residence is associated with risk for arthritis, poor health outcomes, and healthcare disparities. **Purpose:** This study's purpose is to describe differences in the health and well-being of late middle-aged (50-64 years), rural-dwelling Hispanic adults with and without arthritis. **Methods:** We conducted a cross-sectional analysis of 40 Hispanic adults (mean age=57.6 years, SD=4.8) who were participating in a feasibility study of a lifestyle intervention delivered in a

primary care system in rural California, USA. Participants reported on medical diagnoses, including arthritis of any type, and various health and well-being parameters. We analyzed a subset of the measurement battery that holistically represented health and wellness: satisfaction with social activities, physical activity engagement, sleep quality, and general well-being. **Results:** All participants were Spanish-speaking and 90% were female. Those who reported arthritis (n=19, 47.5%) showed significantly poorer social activity satisfaction ($p=0.05$), physical activity participation ($p=0.04$), and general well-being ($p=0.04$) compared to non-arthritic participants. Although not statistically significant, individuals with arthritis also reported poorer sleep quality. **Conclusion:** This small cross-sectional study showed that self-reported arthritis was highly prevalent in a sample of late middle-aged, rural-living Hispanics. Similar to previous findings in elders, the presence of arthritis was associated with poor health and well-being in multiple domains. While a larger-scale study is necessary to confirm these preliminary findings, this study informs efforts to develop lifestyle interventions tailored to vulnerable, late mid-life Hispanic individuals with arthritis and who are residing in rural communities nationwide.

Poster #: 7

Title: Older adults' self-identified physical activity goals to support weight management
Name: Stacey Schepens Niemiec

Background: Older adult obesity, a rising issue in the United States, is associated with functional decline and institutionalization. Despite this public health problem, older adults are not often targets for weight management. Accordingly, little is known about effective strategies worth integrating into older adult-tailored weight control programs. **Purpose:** We examined associations between weight change and physical activity (PA) related goals that older adults set in a lifestyle modification program. **Methods:** We retrospectively reviewed charts of 26 older adults (mean age=70.1 years, SD=4.0, range 65-79) who were referred to a university-sponsored,

lifestyle-based weight management program. **Results:** Weight loss was similar in participants who set a PA goal—with or without goal specifications such as intensity or duration—compared to those who did not set PA goals (Mann-Whitney U test $p=0.906$). However, participants who had more specifically defined PA goal parameters (e.g., duration of PA engagement) had slightly but significantly greater weight loss than individuals who articulated only general PA goals (Mann-Whitney U test $p=0.031$). The positive association between average number of specifications made per PA goal and weight change approached significance (Kendall's tau $p=0.055$). **Conclusion:** In this sample of older adults who participated in a lifestyle-based weight management program, modestly greater weight loss was experienced by elders who set more specific PA benchmarks as opposed to general PA goals. Though future studies are warranted to confirm our findings, this preliminary study suggests that encouraging older adults to define their PA goals with more precision supports elders in achieving greater weight loss.

Poster #: 8

Title: Modular multi-functional dental implant coatings for improved tissue response
Name: Malcolm Snead

Background: In the US, ~1.3 x 10⁶ new dental implants were placed in 2013 with an expected doubling by 2020. Implant osteointegration is dependent on the implant surface bioactivity to induce Wnt-integrin signals, but implant bioactivity is reduced by 6 months post-manufacturing. The Cochrane meta-analysis report estimated the incidence of peri-implantitis with bone loss leading to implant failure as 1.6% after 3 years and 5.5% at 10 years. Derks and colleagues placed the peri-implantitis incidence at ~14.5% after 9 years of service. **Purpose:** There is a clinical need to restore a surface-autonomous physiologic relationship between the implant and host by: 1) improving early osteointegration; 2) slowing or preventing the failure of previously placed implants due to bone loss; 3) reducing oral microbiota colonization of implant surfaces; and 4) extending the ben-

efits of implants to high risk patients. We sought solutions to these needs through engineering, nanotechnology, and molecular and stem cell biology. **Methods:** We developed a technology that delivers a water-based, surface treatment for Ti implants that further improves their success rates and expands their benefits to high-risk patients through an implant coating that delivers bioactive signals for cell differentiation to bone and anti-microbial activity. Further, this coating can be reapplied during a recall visit to extend the life of previously placed implants. Our innovative technology is built around an aqueous bifunctional molecule consisting of an implant anchoring peptide with high affinity binding to Ti/alloys and the choice of several bioactive peptides joined during synthesis through a linker region to optimize their function. **Results:** We developed a peptide binding implant (PBI) anchor and combined it with bone inducing peptide (BIP) to guide cells towards the osteogenic lineage in a controlled and predictable way. BIP activates the Wnt/beta-catenin signaling pathway, stimulating osteogenesis by increasing osteoblastic transcription factors, without direct application of Wnt proteins, thus mitigating the adverse effect of direct Wnt protein exposure. **Conclusion:** We show that PBI-BIP tethered to a Ti implant surface remains functional and activates the Wnt pathway to induce bone formation. We are innovating other bifunctional peptides, including an anchoring peptide linked with an anti-microbial peptide that can modulate biofilm formation.

Poster #: 9

Title: Probing social motivation heterogeneity in young children
Name: Barbara Thompson

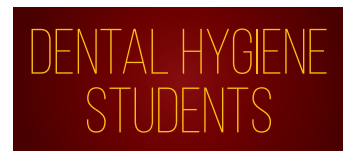
Background: There are vast knowledge gaps in understanding neurobiological mechanisms that contribute to the broad heterogeneity seen in social-affective behavior across human populations. While it is well documented that children with autism spectrum disorder (ASD) show disruptions in social behaviors, the underlying mechanisms driving those disruptions is less understood. **Purpose:** The first goal was to build upon our previously established para-

digm of conditioned place preference (CPP) for use in young typically developing (TD) children by adapting the task for use with a social unconditioned stimulus. The second goal was to use the social CPP task to probe whether the social interaction phenotype in children with ASD is due to an aversion to social interactions or, alternatively, a lack of reward from social interactions. **Methods:** Typically developing children and children with ASD aged 36-60 months participated in this social CPP task. The task utilized Pavlovian conditioning methods in which a conditioned stimulus (CS) was repeatedly paired with an unconditioned stimulus (US), which elicited an unconditioned response (UR), and after successful conditioning, the CS elicited a conditioned response (CR) similar to the UR. Using a novel social experimenter as the US, and a custom-designed child-friendly arena, a castle, as the CS, the CS was paired with the US across four conditioning trials, and we then measured place preference scores when the US was not present. **Results:** Our results demonstrate that TD children display a robust social CPP ($p < 0.05$) and that CPP scores correlate with sub-scales of the Mullen Scales of Early Learning. In comparison, the ASD group shows more heterogeneous conditioning scores in the social CPP task, revealing less preference for the social US in our preliminary data. **Conclusion:** There is significant heterogeneity in the behavioral characteristics and genetic underpinnings of social behaviors in both TD children and children with ASD. The establishment of reliable and robust behavioral paradigms that can reveal differences in motivation, reward, and aversion for social stimuli, as utilized in this study, promises to transform approaches to assessment and intervention in young or low-verbal children, and to illuminate potential underlying neurobiological mechanisms responsible for the observed heterogeneity. This will allow for more precise interventions to target and reduce core social-affective symptoms of ASD.

Poster #: 10

Title: Amelogenin isoform LRAP induces Wnt3a to regulate human MSC fate
Name: Yan Zhou

Background: Compelling evidence from both *in vitro* and *in vivo* experiments indicate a reciprocal relationship between osteoblasts and adipocytes, with these two cell lineages being derived from a common progenitor, the mesenchymal stem cells. The pathophysiological linkages between osteoporosis and marrow adiposity suggest that small therapeutic molecules may be able to affect both compartments by influencing the fate of mesenchymal stem cells. **Purpose:** Previously, we demonstrated in mouse models that a naturally occurring 59-amino-acid peptide, LRAP, promotes osteogenesis of mesenchymal stem cells at the expense of adipogenesis through upregulating Wnt10b expression to activate the canonical Wnt signaling. Due to the differences in gene expression and genomic responses between mice and humans, results obtained in mice might not carry over to humans. **Methods:** In this study, we employed human bone marrow mesenchymal stem cells (hBMMSCs) to characterize the therapeutic potential of LRAP to control mesenchymal stem cell fate. **Results:** LRAP stimulates osteogenesis and inhibits adipogenesis of hBMMSC cells. LRAP treatment elevates beta-catenin protein level in hBMMSC cells. Wnt antagonist sFRP1 abolishes the effect of LRAP on the stimulation of osteogenesis and the inhibition of adipogenesis of hBMMSC cells. LRAP treatment results in the upregulation of Wnt3a expression in hBMMSC cells, in comparison to Wnt10b in mice. **Conclusion:** We have identified a naturally occurring 59-amino-acid peptide molecule to control mesenchymal stem cell fate by activating the Wnt/beta-catenin signaling pathway in both humans and mice. This peptide has the potential to be developed as a therapeutic agent to increase bone mineral density while decreasing marrow adiposity concurrently for more effective treatment of osteoporosis.



Poster #: 11

Title: A correlation between whey protein and oral health

Name: Mariesa Abad

Faculty Advisor: Joane Beleno-Sanchez

Background: Preventative dentistry to manage dental diseases has encouraged new applications of alternative methods. Casein phosphopeptide-amorphous calcium phosphate (CPP-ACP) and proteose-peptone 5 that are found in whey protein, a common protein supplement, have been shown to have oral health benefits. **Purpose:** Identify, investigate, and assess the components of whey protein that improve oral health. **Methods:** The enamel microhardness of 30 extracted human premolars was measured using a microhardness 3-point force exam before immersion in 40-ml of soda beverage for 8 minutes randomly followed by CPP-ACP, whey protein, or control group (artificial saliva) for 10 minutes. The changes in microhardness were recorded and analyzed. Adult participants (n=3,287) were asked to participate in an oral health survey on dietary intakes. Two random quadrants per participant were assessed by three hygienists for advanced periodontal disease as defined by the American Dental Association and Center for Disease Control. **Results:** The increase in enamel microhardness in the CPP-ACP, artificial saliva, whey protein groups were 8%, 17%, and 30% respectively. Of the participants, 339 were diagnosed with advanced periodontal disease and lower consumption rate of whey foods and high sucrose intakes. Conversely, higher consumption of calcium, whey protein, and casein were associated with a lower risk of developing advanced periodontal disease. **Conclusion:** The results indicate that components found in whey protein provide anti-cariogenic properties and lower the risk for periodontal disease. Further randomized controlled studies on whey protein and possible incorporation in natural preventative therapeutics may bring an advancement in the clinical management of oral diseases.

Poster #: 12

Title: Developing an observational method for assessing dental hygienists' injury risk
Name: Nikki L. Colclazier
Faculty Advisor: Joyce Y. Sumi

Background: Dental hygienists have a high prevalence of work-related musculoskeletal disorders (WMSDs) due to repetitive mo-

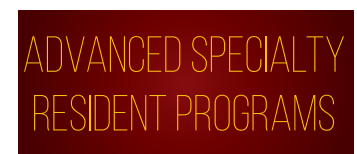
tions and sustained postures. No standardized method exists for evaluating risk factors in the clinic. **Purpose:** Develop an observational method to evaluate risk for WMSDs in dental hygienists. **Methods:** With IRB approval and informed consent from participants and their patients, videos of five student dental hygienists were obtained during patient care. Two stationary cameras captured a wide-angle view of body positions and a close-up view of the hand and wrist during scaling. Videos were coded by activity, time spent in each clock-position (CP) and area of the mouth (AOM). Sustained postures (i.e., >45-sec in one CP/AOM) were evaluated using the rapid upper limb assessment (RULA). **Results:** Average appointment time was 178 minutes (2.9 hours). Instrumentation took 57% of the appointment, 82% of which was spent performing hand scaling. Students worked most frequently in the 9-CP (40% of the time), with equal time in each AOM. Sustained postures were noted in 71 video segments. Overall RULA scores were distributed around modes of 4 and 6, and the most frequent poor postures were wrist flexion and neck flexion. 18% of video segments were unable to be assessed due to a blocked view. **Conclusion:** RULA scores of 4-6 indicate moderate risk for these students. The observational method was found to be feasible; however, adding a third view may improve analysis of sustained postures. Additionally, assessing hand strain during scaling may assist in evaluating risk for WMSDs.

Poster #: 13

Title: The link between periodontal pathogens and Alzheimer's disease
Name: Carolina Montoya
Faculty Advisor: Joan Beleno-Sanchez

Background: Alzheimer's disease (AD) is a progressive condition that slowly deteriorates one's cognitive functions. AD and periodontal disease have been associated with systemic inflammation. Periodontal pathogens have been shown to illicit inflammatory responses that may lead to tissue destruction and alveolar bone loss. This subgingival periodontal infection serves as a peripheral infection that may disseminate to distant organs. **Purpose:** To understand the relation-

ship between periodontal disease and AD and the possible role of periodontal pathogens in the onset and progression of AD. This study will explore the inflammatory effects of periodontal disease on the oral cavity and distant organs and the possibility of serum antibody levels serving as predictors for the onset of AD. **Methods:** An SR outlining the mechanism of how periodontitis can lead to cognitive decline and AD. An *in vitro* study conducted on 12 mice that examined whether certain periodontal pathogens can disseminate to distant organs. A RCT on 158 cognitively intact people diagnosed with chronic periodontitis, studied serum IgG antibody levels associated with specific periodontal pathogens and their relationship to cognitive decline. **Results:** There is a potential link between the bacterial pathogens present in diseased periodontal tissues and the inflammatory process that is associated with AD. **Conclusion:** As periodontal disease progresses, inflammatory markers in the oral cavity elevate and trigger inflammatory markers in systemic blood circulation. Periodontal pathogens then enter the circulation and travel to distant sites, such as the brain, where they may stimulate inflammatory markers that may affect brain function and lead to cognitive decline.



Poster #: 14

Title: Influence of a novel self-priming etchant on bond strength to glass-ceramics
Name: Haifa Alsobiyl
Faculty Advisor: Jin-Ho Phark

Background: For optimal bonding to glass-ceramics, the intaglio surface is treated with highly toxic hydrofluoric (HF) acid followed by silane application. A recently introduced self-etching ceramic primer (Monobond Etch&Prime) with less toxicity might be a suitable substitute. **Purpose:** To evaluate the influence of a novel self-priming ceramic etchant on micro-tensile bond strength (μ TBS) compared to leucite reinforced glass-ceramic and lithium-disilicate reinforced glass-ceramic. **Methods:** Leucite reinforced glass-ceramic (Empress

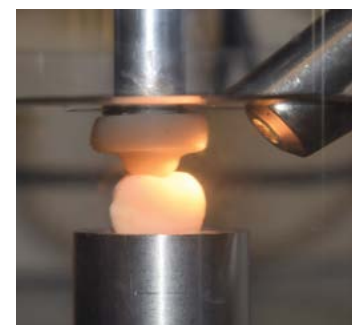
CAD) surface treatments: G1: no surface treatment, G2: 60 seconds HF acid, no silane, G3: 60 seconds HF acid, silane, G4: MBEP 20 seconds and left for 40 seconds, G5: MBEP 20 seconds and left for 100 seconds. Lithium-disilicate reinforced glass-ceramic (e.max CAD) surface treatments: G6: 20 seconds HF acid, silane, G7: MBEP 20 seconds and left for 40 seconds, G8: 20 seconds HF acid, no silane, G9: no surface treatment, G10: MBEP 20 seconds and left for 100 seconds. All ceramic specimens were cemented with a dual cure resin cement (RelyX Ultimate) to ceramic reinforced polymer specimens (Lava Ultimate), then sectioned and subjected to μ TBS testing after 24 hours or 6 months of storage in distilled water. **Results:** For groups 1-5, μ TBS ranged from 21.45 to 45.15 MPa for non-aged specimens and from 0 to 38.81 MPa for aged specimens. For groups 6-10, μ TBS ranged from 0 to 49.50 MPa for non-aged specimens and from 0 to 32.10 MPa for aged specimens. **Conclusion:** Long-term efficacy of self-priming ceramic primer is highly dependent on the ceramics' composition and structural arrangement.

Poster #: 15

Title: Maxillary sinus floor pneumatization in post-extraction sockets with ridge preservation
Name: Essa Alwazan
Faculty Advisor: Homa Zadeh

Background: Post-extraction dimensional changes in alveolar ridge crest and the role of ridge preservation have been well-studied. However, post-extraction resorption in the apical region of maxillary molars and related maxillary sinus pneumatization have not been investigated. **Purpose:** The aim of the present retrospective study was to investigate the correlation between specific anatomic attributes of teeth and alveolar bone and the dimensional changes in maxillary sinus floor in post-extraction sockets treated by ridge preservation. **Methods:** Pre-op linear measurements were made using Simplant 16.0 software in pre- and post CBCTs of 13 individuals who had maxillary molar tooth extraction and ridge preservation with anorganic bovine bone mineral (ABBM). **Results:** Results revealed that the sinus floor vertical height change had a mean gain of 1.3 mm at the mesio-buccal

root (range: 0.32—2.83 mm), 0.53 mm at the disto-buccal root (range: 0.08-1.21mm), and 0.88 mm at the palatal root (range: 0.08-2.82 mm). Marginal alveolar level change had a mean loss of 1 mm (range: -3.43-5.01 mm) at the mesio-buccal root, 1.27 mm (range: -1.28- 4.74 mm) at the distobuccal root and 1.19 mm (range: -2.46-2.91mm). **Conclusion:** The results of this retrospective analysis demonstrated minimal linear dimensional changes in marginal bone height as well as maxillary sinus floor following extraction and ridge preservation grafting with anorganic bovine bone minerals (ABBM). This study has important clinical implications, suggesting that maxillary molar tooth extraction managed by ridge preservation with ABBM can lead to stable alveolar bone outcomes. The relative effects of ridge preservation on sinus floor dimensional changes has to be substantiated experimentally in a future randomized control clinical trial that will also include a non-grafted control group.



Poster #: 16

Title: Evaluation of marginal chipping with three different margin configurations for CAD/CAM restorations
Name: Khaled Alzahrani
Faculty Advisor: Winston Chee

Background: Margin configuration can affect outcomes when using CAD/CAM technology to fabricate restorations. This study suggests that shoulder or margins 90 degrees to the external surface of the tooth exhibit less chipping during the machining process for the materials tested. Clinicians should take this into account when preparing a tooth to receive restorations that are machined. **Purpose:** The aim of this study is to compare the edge integrity of machined IPS e.max to Lava™ Ultimate restorations manufactured with CAD/CAM and to investigate the ability of the CEREC MC XL

machine to produce restorations with acceptable margins at different marginal angles. **Methods:** A single die was fabricated in Jet Acrylic with three different finishing lines; namely a 60° bevel, a 30° bevel and a 0° bevel (or 90° shoulder). The CEREC Blu-Cam with version 4.4 software (Sirona Dental Systems GmbH) was used for scanning and milling ten copings for each material. The IPS e.max CAD and Lava Ultimate blocks were used to construct the copings for each of the three marginal configuration groups. To determine the marginal integrity of the crowns, an estimation of the degree of marginal chipping was performed by calculating the chipping factor (CF) of each restoration. An analysis of the images taken of the marginal areas with the restoration seated on the test dies were performed using ImageJ 1.50e software. **Results:** The IPS e.max with 60° finish line demonstrated the poorest marginal integrity while the Lava Ultimate with shoulder margin exhibited the fewest defects. A one-way analysis of variance and pairwise multiple comparisons were used to find any statistical differences between the materials and different marginal angles. A significant difference between the CF for 60° finish line and 0° finish line for both materials was found. Furthermore, Lava Ultimate had better edge fracture behavior than IPS e.max with the 60° preparation design. **Conclusion:** The results showed a statistically significant difference in edge fracture with different marginal designs. Within the limitations of this study, we can conclude that the 60° finish line for both materials demonstrated a higher chipping factor compared to the 0° finish line. Moreover, a shoulder finish line can be recommended as the margin of choice for CAD/CAM restorations made with these two materials.

Poster #: 17

Title: Analysis of ABO Model Grading System: plaster versus digital models

Name: Amanda Budiman

Faculty Advisor: Glenn Sameshima

Background: The American Board of Orthodontics (ABO) developed the Model Grading System to enhance the reliability of examiners and to provide the examinees the tools to assess the adequacy of

their finished orthodontic results. In recent years, the ABO has begun to accept pre- and post-treatment models in digital format. **Purpose:** The purpose of this study is to determine if there are statistical differences between plaster and digital orthodontic models in scoring the ABO Model Grading System. **Methods:** 12 post-treatment plaster orthodontic study models were selected based on the criteria that each have been submitted to the ABO clinical exam and passed with a score between 10-30. The study models were scanned and oriented using Motion View's Ortho Insight 3D to produce 12 corresponding digital models. 12 orthodontic residents graded the plaster and digital models using the ABO Model Grading System. Digital models were graded using the ABO Model Conversion Utility software (Motion View, Chattanooga, TN). The variables evaluated include alignment, marginal ridge, buccolingual inclination, occlusal contacts, occlusal relationship, overjet, and interproximal contacts. **Results:** The intraclass correlation coefficient between plaster and digital models showed very poor reliability for alignment and only fair reliability for marginal ridge, buccolingual inclination, occlusal contacts, occlusal relationship, overjet, interproximal contacts, and total score. High intraclass correlation coefficient of reliability for 2 examiners that repeated the grading demonstrates agreement for all variables and total score when done by the same examiner. The reliability for digital models was also higher than plaster models for both examiners. **Conclusion:** Based on this study, the current ABO Model Conversion Utility software was not adequate for scoring all the criterion of the ABO Model Grading System and adequate calibration of the examiners is essential to achieve repeatability in both plaster and digital methods.

Poster #: 18

Title: Anti-BMP2 immobilized on anorganic bovine bones for tissue engineering

Name: Goncalo Carames

Faculty Advisor: Homa Zadeh

Background: Antibody Mediated Osseous Regeneration

(AMOR) involves immobilization of anti-BMP2 mAb on a scaffold. AMOR is intended to capture endogenous BMPs, inducing osteogenic differentiation of mesenchymal stem cells. The effectiveness of AMOR has been extensively investigated within critical size intraosseous defects in rat, rabbit, dog and non-human primate models. **Purpose:** This study sought to evaluate the efficacy of chimeric anti-BMP2 mAb immobilized on anorganic bovine bone mineral with 10% Collagen (ABBM-C) block stabilized with MODfix screws in bone tissue engineering **Methods:** 8 New Zealand White rabbits were used in this study. An extraoral flap was used to expose the mandible. MODfix modular titanium screws were installed into the inferior border of the mandible. ABBM-C was pressed through the two MODfix screws followed by attachment of tenting abutment. The ABBM-C for the test group was incubated with chimeric anti-BMP2 mAb (25 mg/ml) and for the control group with isotype matched control mAb. After 12 weeks, animals were sacrificed, specimens were imaged by cone beam computed tomography (CBCT) analysis followed by histomorphometric analysis. The bone volume/total volume (BV/TV), % void volume, % residual graft, linear bone gain, linear bone gain around implant, number of osteoclasts and number of osteoblasts were measured and compared among groups. **Results:** Histologic observations in the AMOR group revealed strongly eosinophilic osteoid tissue containing round to ovoid osteocytes within lacunae demonstrating its viability. The active apposition of osteoblastic cells with large nuclei and occasional osteoclasts were observed within Howship's lacunae or resorption pit adjacent to osteoblasts, all indicating active remodeling of the bone. New bone formation in the AMOR group was restricted to the region near the host bone, as well as continued up on the tenting screws. No evidence of osteogenesis was noted in the control group. Histomorphometric analysis revealed: % BV/TV (12.2% vs 5.1%), % void volume (52.3% vs 39.1%); % residual graft (35.5% vs 55.8%); linear bone gain around MODfix titanium screws (2.8mm vs 0.8mm); linear bone gain in alveolar ridge (0.9mm vs 0.4mm); number of

osteoclasts (1.2 vs 1.0 cells/field); number of osteoblasts (61.5 vs 33.7 cells/field), for AMOR vs control groups, respectively. **Conclusion:** The results of the present study demonstrated increased de novo bone formation in sites implanted with ABBM-C functionalized with immobilized anti-BMP2 mAb installed on the inferior border of the mandible with MODfix tenting screws. In the absence of appropriate signaling molecules, osteogenesis did not occur within the control scaffold. It will be important to determine whether the limitation in *de novo* bone formation may be due to limitation of endogenous BMPs to regions near host bone.



Poster #: 19

Title: 3D volumetric changes of tissue contour after immediate implant placement

Name: Ramon Ceballos Gavilan

Faculty Advisor: Homa Zadeh

Background: Using anorganic bovine bone mineral (ABBM) in the facial gap when placing immediate implants is a very common procedure, but no evidence is available about its effects in terms of volumetric changes, nor in papilla height change or zenith position change. Some evidence is needed in order to support or not its use to minimize the alveolar changes that occur after an extraction. **Purpose:** The aim of this randomized controlled clinical trial was to evaluate whether placement of a bone graft in the facial gap at immediately placed implants in the anterior maxilla influences the position of the mid-facial mucosal zenith. **Methods:** Patients with a need for a single-tooth replacement in the anterior maxilla were enrolled in this study. Following tooth extraction, implants with sloped platforms (Astra Tech Osseospeed Tx Profile) were placed into the extraction sockets without flap elevation. Randomly assigned experimental sites received ABBM in the facial gap, while the gap in control sites

were left unfilled. Alginate impressions were obtained at baseline and one year after the date of implantation. Dental stone casts were optically scanned and STL files were imported into reverse engineering software (Geomagic Control) for 3D quantitative analysis. Linear and volumetric measurements were performed to evaluate the dimensional alterations, including positional changes of the mid-facial mucosal zenith, the mesial and distal papilla height position change, 3D volumetric changes on the tissues apical to the mucosal zenith as well as horizontal contour changes at 1, 2, 3, 4, and 5 mm from the position of gingival margin one year after implant installation. **Results:** Patients in both test and control group healed uneventfully after implant placement. The mean mucosal zenith change in the grafted and non-grafted groups were 0.68 ± 0.19 and 0.75 ± 0.03 mm, respectively. There were no statistically significant differences between the two groups. In the graft group, the mean horizontal dimensional loss at 1, 2, 3, 4, and 5 mm was 0.96 ± 0.57 mm, 1.06 ± 0.76 mm, 1.11 ± 0.62 mm, 0.99 ± 0.43 mm, and 0.86 ± 0.49 mm, respectively, while the non-graft group showed 0.45 ± 0.22 mm, 0.68 ± 0.26 mm, 0.72 ± 0.18 mm, 0.80 ± 0.20 mm, and 0.83 ± 0.34 mm, respectively. There was no statistically significant difference between the two groups. The mean mesial papilla loss was 1.34 ± 0.74 mm and 0.79 ± 0.39 mm for the test and control group, respectively. The mean distal papilla loss was 0.95 ± 0.64 mm and 0.77 ± 0.53 mm for the test and control group, respectively. The differences in these results were not statically significant. The mean volume loss was 30.69 ± 16.56 mm³ and 20.48 ± 7.22 mm³ for the test and control group, respectively, but this difference was not statically significant. **Conclusion:** The results of this study demonstrated that, when utilizing the particular protocol of this study with careful flapless tooth extraction, implant placement with at least 2mm horizontal gap to the facial alveolar bone, implant with sloped platform, only minor mucosal dimensional changes in soft tissue surface mucosa were observed. The addition of ABBM in the horizontal gap of the socket failed to show a positive influence in the

outcome of the facial peri-implant surface mucosa.

Poster #: 20

Title: Fit of lithium disilicate crowns: CAD/CAM vs heat-pressed
Name: Sonchhanin Chinswananon
Faculty Advisor: Winston Chee

Background: Chairside CAD/CAM technology has improved considerably over the past few years, however, the marginal and internal adaptation of dental restorations fabricated with these systems remains controversial, especially when compared to the heat-pressed technique. **Purpose:** The objective of this *in vitro* study was to evaluate the marginal and internal adaptation of lithium disilicate crowns fabricated with a CAD/CAM system as compared to the conventional heat-pressed technique. In addition, this study evaluated the influence of different spacer thicknesses on the accuracy of lithium disilicate restorations fabricated with the Sirona CEREC CAD/CAM system. **Methods:** A total of 40 lithium disilicate crowns were fabricated and divided into 4 groups: 30 crowns with CAD/CAM for the first 3 groups, with different spacer thickness settings: 30 µm, 60 µm, and 120 µm; and 10 crowns with the heat-press technique. Occlusal gap, axial wall gap, and marginal gap were evaluated by measuring the polyvinylsiloxane material captured between the restoration and test die. **Results:** The heat-pressed group showed significantly lower marginal and internal gaps than the CAD/CAM groups. **Conclusion:** The heat-pressed crowns yielded superior marginal and internal restoration adaptation. For the CAD/CAM groups, 30-µm or 60-µm spacer settings could be recommended for the CEREC CAD/CAM system.



Poster #: 21

Title: 3D superimpositions in or-

thodontics: review of current techniques and applications

Name: Natalie Dang

Faculty Advisor: Glenn Sameshima

Background: As the technology continues to improve, the application of 3D imaging is becoming more accessible and practical. The various applications of 3D technology in the field of orthodontics have allowed for advances in diagnosis, treatment planning, and orthodontic techniques. The superimposition of 3D images can be accomplished using three distinct methods: 1. point-based, 2. surface-based, 3. voxel-based. Each of these techniques has certain criteria required of the images and use a specific algorithm for proper alignment and registration. Each of these different methods have their own advantages and disadvantages and differ in their ease of use, efficiency, accuracy, time required, and cost. **Purpose:** The purpose of this review is to provide some insight into the different 3D superimposition procedures and programs that will help guide its effective use to further our understanding of orthodontics. **Methods:** N/A **Results:** A review of the literature has revealed success in using certain superimposition techniques for the registration of particular structures and limitations for others. The use of 3D superimpositions for specific applications and a discussion of its accuracy is presented in this review. It was found that surface-based methods are the most accurate and reliable for the superimposition of digital dental models. Meanwhile, point-based methods are the most accurate and reliable for the superimposition of the TMJ to assess changes in morphology. For the superimposition of 3D cephalometrics derived from cone beam computed tomography (CBCT) scans, voxel-based methods are the most robust and avoid errors resulting from landmark identification or segmentation procedures. The evaluation of soft tissue changes is an area that could be much improved. Some studies have shown point-based and surface-based methods to be accurate, but should be held with some reservations due to the dynamic nature of facial soft tissue. Voxel-based registration on the cranial base has been shown to be the more reliable method, but the main issue with this technique

is the inferior image quality for soft tissue. **Conclusion:** With the use of 3D superimpositions being relatively new to the field of orthodontics, its potential for use in the research and clinical settings is still in its early stages. As can be seen through some of its limitations, much can still be improved as to how 3D registrations can be performed and applied. Nevertheless, as technology and techniques improve, registration of 3D images will become faster, easier, and more efficient to help transform and advance the way orthodontists diagnose and treat patients.

Poster #: 22

Title: 3D volumetric analysis of post-extraction maxillary sinus floor pneumatization

Name: Sara Elhusseini

Faculty Advisor: Homa Zadeh

Background: Dimensional changes of the alveolar ridge crest following tooth extraction have been extensively studied. However, post extraction changes in the maxillary sinus floor have not been investigated. **Purpose:** The aim of the present retrospective study was to explore changes to the maxillary sinus floor using 3D volumetric analysis **Methods:** 25 pre- and post-operative cone beam computed tomography (CBCT) images of 24 individuals who had maxillary molar tooth extraction at the USC Ostrow School of Dentistry were imported into Mimics software (Materialise Interactive Medical Image Control System, Belgium). Pre- and post-operative CBCT studies were segmented so that discreet volumes of the maxillary sinus were created. The volumes of the pre-op and post-op sinus were oriented and superimposed. Cross sections were made perpendicular to the curvature of the maxillary arch in the center of each extracted tooth. These superimposed pre-op and post-op images were utilized for two-dimensional analysis of the sinus **Results:** Examination of representative superimposed pre-op and post-op CBCT images revealed very little change in the position of the maxillary sinus floor following tooth extraction. This is consistent with linear measurements from 2D images reported by Hameed et al. (abstract submitted for USC Research Day), who have observed that the mean sinus floor

vertical height changes were 0.62, 0.37, and 0.4mm and the mean crestal bone height changes were 3.07, 3.33 and 2.99 in the sites of the mesiobuccal (MB), distobuccal (DB) and palatal (P) maxillary molar roots, respectively. Linear measurements of superimposed pre-op and post-op CBCT 3D volumes is currently in progress and will be available for reporting in the USC Research Day poster. **Conclusion:** The preliminary results of this retrospective 3D volumetric analysis, in concert with linear analysis of 2D data, suggest that the maxillary sinus floor undergoes insignificant positional changes following extraction of maxillary molars.

Poster #: 23

Title: Buffered vs non-buffered lidocaine in mandibular nerve block: a meta-analysis
Name: Jing Guo
Faculty Advisor: Reyes Enciso

Background: Local anesthetics are a key component of endodontic treatment. Epinephrine serves as an addition in anesthetic agents to achieve prolonged anesthetic effect. A lower pH is required to prolong the shelf life of epinephrine. The acidity of the solution contributes to injection pain and increases onset time. Although buffered lidocaine has been reported in medicine for reducing injection pain, the effect of alkalization of lidocaine in dentistry remains controversial. A relevant meta-analysis has been lacking. **Purpose:** The purpose of this meta-analysis was to evaluate the effectiveness of buffered lidocaine versus non-buffered lidocaine in mandibular inferior alveolar nerve block (IANB). **Methods:** Electronic searches were conducted in Medline, Scopus and Cochrane Library by using strict inclusion and exclusion criteria. The eligibility of inclusion was assessed by two independent reviewers. Inclusion criteria were: 1) randomized controlled trials, 2) interventions compared non-buffered 2% lidocaine with epinephrine and 9:1 buffered 2% lidocaine with epinephrine using 8.4% sodium bicarbonate for IANB, 3) outcomes with injection pain and onset time. Treatment outcomes were combined by meta-analysis using random- and fixed-effects methods. **Results:** Buffered lidocaine is more like-

ly to have faster onset time compared to non-buffered lidocaine with a weighted mean difference of 54 seconds (95% CI, [-61.73, -46.26], $p < 0.00001$). There is no statistically significant difference of injection pain. **Conclusion:** A conclusion of faster onset time of buffered lidocaine is made based on current studies. However, due to the limited number of studies, the conclusion should be carefully interpreted. More randomized clinical trials of high quality are desired for further evaluation.

Poster #: 24

Title: Does the maxillary sinus pneumatize following maxillary molar tooth extraction?
Name: Sabina Hameed
Faculty Advisor: Homa Zadeh

Background: Maxillary sinus pneumatization has been proposed to occur after maxillary tooth extractions. Dimensional changes occurring in the alveolar crest after extraction have been extensively studied; however, maxillary sinus pneumatization and its possible relationship to maxillary molar extraction have not been investigated. **Purpose:** The aim of this retrospective study was to investigate post-extraction spatial and dimensions changes in the maxillary sinus floor and alveolar crest. **Methods:** 25 pre- and post cone beam computed tomography (CBCT) scans of 24 individuals who had maxillary molar tooth extraction were analyzed using Simplant 17.0 software. Pre- and post-operative CBCTs were oriented and aligned by utilizing coincident reference lines. Measurements were made for mesiobuccal (MB), distobuccal (DB) and palatal (P) roots for the distance of the root apex to the sinus floor, width of root apex at 2mm from the apex, inclination of the root to the sinus floor, height of alveolar crest, and reference line to the maxillary sinus floor. **Results:** Results revealed that the mean sinus floor vertical height changes were 0.62, 0.37, 0.4mm and the mean crestal bone height changes were 3.07, 3.33 and 2.99 in the sites of MB, DB and P maxillary molar roots, respectively. No statistically significant correlation was found between the root anatomical factors and sinus height change. **Conclusion:** The results of the present study challenge the

commonly held concept that maxillary sinus pneumatization occurs following extraction of maxillary molars. Instead, extensive alveolar crest dimensional changes were observed, consistent with published reports. Further research is needed to confirm these observations.



Poster #: 25

Title: Influence of scanning sequence and edentulous ridge on intraoral scan.
Name: Wei Hung He
Faculty Advisor: Winston Chee

Background: Intraoral scanning is rapidly replacing impression-taking in order to fabricate indirect restorations. However, when more extensive restorations are required they have been found to be less accurate than acceptable. There is a need to understand the reasons for the inaccuracies for future development. **Purpose:** The purpose of the present study is to evaluate the effects of the length of edentulous area and scanning sequence on the accuracy of a full arch intraoral scan. **Methods:** A master model with teeth from #2 to #15 was fabricated with three verification points (tuberosity areas bilaterally and incisive papilla). The master model was duplicated with scannable stone (New FUJIRock IMP). The master model was modified by removing teeth in the sequence of #8, #9, #7, #10, #6 and the ridge smoothed. Six duplicate models with different lengths of edentulous areas were made. Digital impressions were made with an intraoral scanner (Planmeca PlanScan) and a lab scanner (Identica Hybrid) for each cast. For intraoral scanning, three different scanning sequences (A, occlusal-facial-palatal, B, facial-occlusal-palatal, C, zig-zag) were used and repeated three times. The lab scanning data were used as the controls. The accuracy and precision of each intraoral scan was measured by digital

superimposition (Geomagic Qualify). **Results:** Highest accuracy was found in sequence C, followed by sequence A. Sequence B showed the least accuracy. With increased length of the edentulous area, accuracy decreased. **Conclusion:** When using intraoral scanners, the scanning sequence and the length of the edentulous ridge may affect the accuracy.

Poster #: 26

Title: The effect of restorative dimension on peri-implant marginal bone loss
Name: Shantia Kazemi Esfeh
Faculty Advisor: Homa Zadeh

Background: The relationship between the dimensions of implant prosthesis and implant outcomes remains controversial with conflicting data. **Purpose:** The aim of the present retrospective study was to evaluate the relationship between implant prosthesis dimensions and peri-implant marginal bone loss (MBL). **Methods:** This double center retrospective study consisted of patients with single unit non-splinted implant restoration with adjacent teeth, in the posterior maxilla or mandible, serving in function for more than one year. Radiographic images were imported into Photoshop (CC 2015, Adobe). Linear measurements were made after calibration of images using known values for implant length and diameter using polygonal lasso tool for surface areas and ruler tool for linear distances. A correlation test was run to analyze the relationship between crown dimensions, crown-to-implant ratio and mesial/distal marginal bone loss. Statistical significance will be considered as p -value < 0.05 . **Results:** This preliminary data included 30 patients with a follow up period up to 72 months. A weak positive linear relationship between prosthesis width and average mesial marginal bone loss was found (0.39=correlation coefficient,) and no correlation between crown width space and average distal marginal bone loss was found. Crown surface space and crown-to-implant ratio were not correlated with average mesial/distal marginal bone loss, respectively. **Conclusion:** The current preliminary data has not rejected the null hypothesis. Accordingly, based on the preliminary results,

there is no correlation between any of the prosthetic dimensional measurements and marginal bone loss. Nonetheless, a weak positive correlation between crown width space and mesial marginal bone loss was observed.

Poster #: 27

Title: Management of non-responsive medication-related osteonecrosis of the jaw: a systematic review
Name: Shantia Kazemi Esfeh
Faculty Advisor: Homa Zadeh

Background: Bisphosphonates are administered widely for prevention of skeletal complications induced by increased osteoclast-mediated bone resorption. One of the main complications of bisphosphonates is medication-related osteonecrosis of the jaw (MRONJ). **Purpose:** The aim of the present study was to perform a systematic review of the literature to assess the available evidence on surgical interventions for MRONJ unresponsive to conservative measures, such as antibiotics, antiseptics and local debridement. **Methods:** Independent searches in MEDLINE (PubMed), Web of Knowledge, SCOPUS, CINAHL, Science Direct, and the Cochrane Library, ProQuest Database of Dissertations and Theses and Google scholar. Included were studies published in English. The focused question was: "In patients with primary malignant disease with a history of IV bisphosphonate therapy, is surgical resective therapy effective for the management of MRONJ unresponsive to conservative management?" Cohen's kappa coefficient was used to calculate the inter-rater reliability in quality assessment and inclusion/exclusion of the articles. **Results:** The initial electronic search identified 295 articles, and title screening of these identified 126 articles for abstract screening. Forty-two articles were selected for full-text review. Finally 11 articles in which radical resective surgery was performed following an unresponsive conservative treatment (noninvasive surgery mainly) were included in this review. Radical resective surgery brought up 100% success in 7 studies and in the remaining 4 studies, high success rate was reported. **Conclusion:** There is a lack of consensus in the treatment of MRONJ. In resistant progressive cases, unresponsive to conservative man-

agement, a surgical protocol has been shown to be effective. The current literature shows increasing support for the surgical management of recalcitrant MRONJ.

Poster #: 28

Title: Crown/implant ratio and marginal bone loss: meta-analysis of prospective trials
Name: Vahid Khoshkam
Faculty Advisor: Homa Zadeh

Background: Multiple systematic reviews have documented the efficacy of short implants in alveolar sites with moderate vertical height atrophy. Short implants in sites with alveolar ridge atrophy are often restored with elongated restoration, leading to relatively high crown-to-implant (C/I) ratio. It is important to investigate the association between increased C/I ratio and potential detrimental biological effects on peri-implant bone. **Purpose:** This systematic review sought to examine the outcomes of long-term prospective clinical trials with respect to possible correlation between C/I ratio and peri-implant marginal bone loss. **Methods:** An electronic search of three databases and hand searching were performed to identify prospective human clinical trials that had reported both crown/implant ratio and peri-implant marginal bone loss with follow-up of at least 36 months. Random-effect meta-analysis was performed to analyze weighted mean difference (WMD) and confidence interval (CI) for recorded variables according to PRISMA guidelines. Weighted linear regression model was used to evaluate R^2 value. **Results:** The publication search yielded 1138 records and 8 prospective trials were finally included for quantitative data analysis. Meta-analysis for the comparison of MBL among selected studies showed a WMD of 0.02 mm, with a 95% CI= -0.07 mm to 0.10 mm ($p = 0.70$). Results failed to show any significant correlation between C/I ratio and marginal bone loss. In addition, weighted linear regression model and low (0.244) R^2 ratio suggested a lack of significant correlation between MBL and C/I ratio. **Conclusion:** Based on the available evidence, no relationship was identified between C/I ratio and marginal bone loss, within the range of C/I and follow-up period tested

Poster #: 29

Title: Vertical level discrepancy of adjacent implants and marginal bone loss
Name: Vahid Khoshkam
Faculty Advisor: Homa Zadeh

Background: The hypothesis tested was that vertical level discrepancy (VLD) of adjacent implants is associated with marginal bone loss (MBL), the effect of which increases as the horizontal position of implants decreases. **Purpose:** The purpose of the present study was to investigate the correlation between the relative vertical and horizontal position of adjacent implants and alterations in crestal bone. **Methods:** The radiographic records of patients who had received multiple adjacent dental implants at two centers were examined. Inclusion criteria consisted of: 1) multiple adjacent dental implants restored with splinted or non-splinted restorations, 2) availability of diagnostic quality radiographs at time of implant installation and at least one year post-implant placement. Parameters of interest were as follows: VLD between the platform of the adjacent implants, horizontal distance between the implants, distance between the implant platform and bone level at the first implant bone contact at the mesial and distal surfaces of the implants designated as bone level. Pearson correlation coefficient was calculated to determine the relationship between implant proximity measurements and MBL. **Results:** 64 patients with the mean age of 61 having 128 implants with the mean follow up period of 51 months fulfilled the inclusion criteria. The data were analyzed with respect to implant/implant units. Pearson correlation test was used to evaluate the association between VLD and MBL at proximal surfaces of adjacent implants. The mean VLD was 1.29 mm and the mean horizontal distance between the implants was 3.91mm. The average MBL after implant placement at the mesial surface of the distal implants and at the distal surface of the mesial implants were 1.09 mm and 0.99 mm, respectively. Correlation test failed to detect significant correlation between the VLD and MBL on either distal surface of the mesial implants ($P = 0.98$) and the mesial surface of the distal implants ($P = 0.57$). **Conclusion:**

This analysis failed to report significant correlation between the VLD and MBL on either distal surface of the mesial implants and the mesial surface of the distal implants. However, investigation of a larger cohort of patients whose implants have been placed with greater VLD (> 3 mm) and/or with smaller horizontal proximity (< 3 mm) is needed to validate these findings.

Poster #: 30

Title: Color stability of tooth-colored provisional materials
Name: Vanessa Leewing
Faculty Advisor: Jin-Ho Phark

Background: Staining and subsequent discoloration of provisional prosthodontic materials may result in patient dissatisfaction and incur additional costs for remakes, which is especially important when the treatment plan requires long-term provisionalization. **Purpose:** To evaluate the influence of surface treatment (polishing vs. glazing) on the color stability of four different tooth-colored polymer-based provisional materials: one conventionally cold-cured PMMA, two CAD/CAM PMMA materials, and one 3D printed provisional material. **Methods:** Rectangular discs 1 mm in thickness were prepared from 1) Jet Acrylic PMMA (conventionally cold-cured), 2) Vita CAD-Temp, 3) Telio CAD, and 4) Dentca (3D printed). All specimens were ground flat and polished. Half of each group was additionally glazed. Specimens were divided into 3 groups to be immersed in solutions of distilled water (control), coffee and black tea for 10 minutes each day. For the remaining time, specimens were stored in distilled water at 37°C. The color of each specimen was measured according to the CIE Lab system at baseline, 2 weeks, 4 weeks, and after polishing using a spectrophotometer (Crystaleye). Color change (ΔE) between various time points and the translucency at each time point were calculated. Data were analyzed using repeated measures of ANOVA. **Results:** Telio CAD showed the least amount of discoloration, followed by Vita CAD-Temp, Dentca, and the cold-cured PMMA specimens. Surface treatment (polishing vs. glazing) did not show any effect on color stability. Staining with coffee resulted in a greater color difference than

staining with black tea. Re-polishing the stained specimens did not result in change of shade, indicating that the discoloration was intrinsic. **Conclusion:** Highly polymerized CAD/CAM PMMA materials showed better color stability than conventionally cold-cured or 3D printed provisional materials. Glazing does not improve color stability. Discoloration is dependent on the staining media used, resulting in intrinsic rather than extrinsic staining.

Poster #: 31

Title: Effect of rotational misfit of implant components on marginal fit
Name: Dan Lin
Faculty Advisor: Winston Chee

Background: With implant components, there is a need for a “non-rotational” feature to fix the components in a certain position, but also a necessary tolerance to allow parts to fit together. This intended “rotational misfit” between components can be between 1.6-5.3 and is commonly misunderstood. With greater rotational play, the fit of a multi-unit cemented prosthesis on the abutments may be adversely affected. **Purpose:** The purpose of this study is to demonstrate the effect of rotational misfit of pre-angled abutments that need to be precisely located from master cast to the oral cavity on the marginal fit of a multi-unit prosthesis. **Methods:** A pre-angled abutment and straight abutment were mounted in plaster and a 3-unit fixed prosthesis to these abutments fabricated. The prosthesis was cemented on the abutments and the marginal gap evaluated. Horizontal rotational differences of 0, 0.5, 1, 1.5, and 2 between implant components were tested. **Results:** An increase in rotational misfit of the angled abutment caused a significant increase in marginal gap between the prosthesis and abutments. **Conclusion:** The rotational misfit of implant components will significantly impact the fit of a cement-retained restoration to the abutments. Due to the built-in tolerances of implant components, it is technically impossible to achieve precise relocation of the abutments. Therefore, it can be assumed that cemented multi-unit restorations often do not seat as intended on abutments.

Poster #: 32

Title: Dimensional changes follow-

ing extraction of maxillary molars
Name: Peiman Mehira
Faculty Advisor: Homa Zadeh

Background: There is little evidence of dimensional changes of the alveolar crest following extraction of maxillary molars. **Purpose:** To investigate retrospectively the dimensional changes that occur in the alveolar crest following extraction of maxillary molars and unassisted healing by performing 3D measurements on cone beam computerized tomography (CBCT) scans. **Methods:** The population of patients who, between March of 2009 and June of 2015, had presented to the Ostrow School of Dentistry of USC for extraction of maxillary molars and had a CBCT taken at both pre- and post-extraction was included in this study. Only those sockets that had undergone unassisted healing were included. Twenty-two patients were identified who had required a total of twenty-four teeth to be extracted. Linear measurements were performed using SIMPLANT PRO 6.0 software. Fixed anatomic locations were used as reference points in order to compare pre- and post-extraction dimensions of the alveolar bone. **Results:** Quantitative analysis of CBCT images demonstrated that the mean (+SD) horizontal thickness of the alveolar bone in the maxillary molar area was 10.4+4.9, 12.1+3.8, 12.8+3.0, 13.4+1.6 mm at 1, 2, 3 and 5mm apical to the alveolar crest, respectively. Following a healing period of 10.9+11.5 months, post-op ridge remodeling was measured as being 84.6+29.3, 68.0+32.7, 49.8+30.8 and 29.1+32.0% of the original width of the alveolar bone at 1, 2, 3 and 5mm apical to the alveolar crest, respectively. The alveolar crest also underwent 2.4+1.4mm of vertical bone loss. Correlations between bone to cemen-to-enamel junction distance on the palate and vertical palatal resorption (P=0.01); mean vertical resorption and mean horizontal resorption (P=0.05); and mean horizontal resorption and palatal plate thickness (P=0.01) correlations were statistically significant. **Conclusion:** Extraction of maxillary molar teeth without additional intervention led to extensive horizontal and vertical bone atrophy that extends at least up to 5mm apical to the original crest. The extensive loss of alve-

olar bone can potentially compromise implant therapy, requiring additional augmentation procedures.

Poster #: 33

Title: Programmable orthodontic expander for treating cleft lip and palate
Name: Ana Moneu
Faculty Advisor: Stephen Yen

Background: Orthodontic preparation for an alveolar bone graft in children with cleft lip and palate requires orthodontic repositioning of the cleft segments into a U-shaped arch that can coordinate with the lower dentition. Current methods for orthodontic expansion require multiple patient visits and orthodontic laboratory support to build the expanders. **Purpose:** The purpose of this study is to evaluate a nickel titanium expander that is reprogrammed by electric current to expand the maxillary segments to a target expansion position. **Methods:** Under an IRB approved protocol, 19 patients were expanded using nickel titanium expanders that required on average one visit to band and weld lingual sheaths and one visit to program the expander and insert the expander into the sheaths. After 2-3 months, the patients were expanded to ideal position based on intraoral measurements. The patients were grafted and followed with a study model and occlusal radiograph at 3 months post-surgery. At 6 months, a restricted-view conebeam CT will be taken. **Results:** Thus far, all 19 patients were expanded in preparation for the alveolar bone graft. Multiple adjustment visits were not necessary. Overall, this expander reduced patient visits, avoided laboratory costs and was accepted by young patients. Complications included breakage of the lingual sheaths, and embedding of the tall springs in palatal tissue. **Conclusion:** The programmable expander can expand the maxilla comparably with the current methods of rapid palatal expansion (RPE) and quad helices with fewer visits.

Poster #: 34

Title: Histological analysis of healing following ridge preservation with different biomaterials
Name: Julio Moreno-Aleman Sanchez
Faculty Advisor: Homa Zadeh

Background: Alveolar ridge resorption has been considered as

an inevitable consequence of tooth extraction. Atrophy of the alveolar ridge may cause aesthetic and functional problems, such as inadequate bone for the placement of dental implants. Ridge preservation has been proposed as a strategy to reduce post-extraction bone resorption. This study examined the histologic response of alveolar bone following ridge preservation. The biomaterial used included Biphasic Graft Material (BGM), which is a resorbable inorganic material derived from red marine algae. BGM consisted of 20% hydroxyapatite and 80% β -tricalciumphosphate. Leukocyte-platelet rich fibrin (L-PRF) was used in another group. **Purpose:** To examine the histologic response of alveolar bone following ridge preservation **Methods:** Thirty-six extraction sockets in 29 patients were randomly assigned to the following four treatment modalities: A: unassisted wound healing; B: L-PRF; C: collagen membrane alone; D: BGM+collagen membrane. Bone core was harvested at 4 months post-extraction for histologic and histomorphometric analysis of wound healing. **Results:** Histologic observations revealed no signs of inflammation. All groups demonstrated that distinct reversal lines were evident in the woven bone, and in areas of active apposition osteoblast-like cells as well as osteoclast-like cell were observed within Howship's lacunae. Histomorphometric analysis revealed the percentage of bone volume relative to tissue volume (BV/TV) for unassisted wound healing, L-PRF, collagen membrane alone, and BGM+collagen membrane were 44±20%, 46±26% 34±14%, and 29±21% respectively. The only statistically significant difference detected was between L-PRF and BGM+collagen membrane (p=0.04). **Conclusion:** The results of vital bone formation observed in the present study were consistent with previous publications. The application of L-PRF was associated with significantly more vital bone than sockets with BGM+collagen membrane. Data regarding the influence of dimensional changes of sockets in various groups is currently under analysis and will be necessary before clinical recommendations can be made.

Poster #: 35

Title: Mouse model for orthodon-

tic tooth movement
Name: Nicha Ungvijanpunya
Faculty Advisor: Stephen Yen

Background: The mouse could be an important genetic model for studying orthodontic tooth movement because of the potential for introducing specific changes in gene expression; however, the small size of the head and anatomy of the molars does not permit the scaling down of other rodent models for tooth movement. **Purpose:** The purpose of this study is to develop a mouse model for orthodontic tooth movement. **Methods:** During necropsy, four Swiss Webster mice were tested for the feasibility of adding orthodontic springs to the molar teeth. Custom retractors were developed to fit the mouse and sutures were used to pin the tongue away from the maxillary arch. After measuring the distance between the molars and incisors, it was determined that there were no commercially available orthodontic springs short enough for this application; therefore, the springs would have to be custom-made. In this case, we made springs from .014 inch stainless steel and .014 inch nickel titanium that would loop around the maxillary incisors and exert a transverse force to narrow the palatal archform. The tooth movement is toward the palate. **Results:** The orthodontic spring was successfully bonded onto the incisors and molars, suggesting that this is a feasible orthodontic model for the mouse. **Conclusion:** This model needs to be tested in a live mouse. In order to prevent bonding failures, mechanical retention will likely be added by cutting grooves in the enamel of the teeth.



Poster #: 36

Title: Implant success rates in ameloblastoma resectioned jaws: a records review

Name: Christie Park
Faculty Advisor: Richard Green

Background: Ameloblastoma is a locally aggressive benign neoplasm of odontogenic epithelial origin in the jaws and surrounding tissue. It is treated with surgical resection to excise the tumor. The bony defects are reconstructed with grafting and placement of dental implants, which are restored with a fixed or removable prosthesis. **Purpose:** The goal of this study is to determine success rates of implants placed in ameloblastoma resected jaws at the LAC+USC Medical Center to better manage future ameloblastoma patients. **Methods:** A records review was performed at LAC+USC Medical Center. Patients were surgically treated for ameloblastoma and grafted with anterior iliac crest. They were restored with dental implants and fixed or removable prostheses. Panoramic radiographs were analyzed for implant failure constituting extraction. **Results:** The sample size was 11 patients with 51 total implants. Overall implant success rate is 74.5%. Of the 13 failed implants, 9 occurred during the first 12 months and 10 during the pre-load phase. **Conclusion:** Most implant failures occur post-surgically but pre-prosthetically. Surgical procedure of implant placement is a critical factor in success. Implant placement technique must be further reviewed to determine reasons for failure.

Poster #: 37

Title: Antibacterial substantivity of sodium hypochlorite on bovine root canal dentin
Name: Stephen Park
Faculty Advisor: Rafael Roges

Background: The antibacterial efficacy of sodium hypochlorite has been well documented in endodontic literature but its substantivity has not been extensively researched. This is a continuation of the study on the substantivity of sodium hypochlorite as an endodontic irrigant and its efficacy over time on bovine dentin. **Purpose:** To compare the substantivity of 8.25% NaOCl and 2% chlorhexidine gluconate on dentin when used as endodontic irrigant. **Methods:** Bovine lower jaws were obtained from Sierra for Medical Science (Whittier, CA). 22 fresh lower incisors were

extracted from the jaws and stored in sterile water for up to 7 days. The clinical crown was amputated from each tooth using a high-speed diamond burr, and the root canal was instrumented utilizing conventional endodontic technique with hand files and Gates Glidden burs. Finally, a #100 K-file was used to create a lumen of at least 10 mm in depth. Each tooth model was irrigated with 20 ml of 8.25% NaOCl and 20 ml of 17% EDTA to remove the smear layer. A final rinse was performed with EDTA with ultrasonic agitation for 2 minutes. Longitudinal grooves, which did not penetrate into the canal, were then placed on facial and lingual surfaces to facilitate their fracture. All roots were then fractured using a plier into the mesial and distal halves. A total of 44 root fragments or “bovine chips” were prepared and then stored in sterile water until further use. Each bovine chip was then placed into a plastic vial containing 2 ml of one of the following irrigants: 8.25%NaOCl, 2% chlorhexidine gluconate, and sterile water. The NaOCl samples were organized into 4 different groups: D1, D2, D4, and D7. Each group contained 6 vials of the irrigant, 5 of which had a bovine chip inside. The chlorhexidine gluconate and sterile water groups were prepared in a similar manner. They were organized into 4 different groups: D1, D2, D4, and D7. Each group contained 3 vials of the respective irrigant, all of which had a bovine chip inside. The vials were incubated at 37°C up to 7 days. D1 samples were removed from the incubator after 1 day, D2 samples were removed after 2 days, D4 samples were removed after 4 days, and D7 samples were removed after 7 days. 0.1 ml of irrigant was then pipetted out of each vial and placed on blood agar plates infected with *Fusobacterium nucleatum*. The plates were then further incubated at 37°C for 7 days and the zone of inhibition was measured. **Results:** To be determined. **Conclusion:** To be determined.

Poster #: 38

Title: Prevalence and characteristics of impacted mandibular second molars in Hispanics
Name: Kristina Sakas
Faculty Advisor: Glenn Sameshima

Background: Clinical experience suggests that a greater percentage

of impacted mandibular second molars (MM2) may be present in Hispanic populations. The prevalence of impacted MM2s has only been reported in a small number of studies, and although several ethnic groups have been investigated, the literature does not include Hispanic populations. A prevalence study must be done to determine if there is increased risk. Characteristics of the impacted molars should also be examined with the intention of finding predictive traits that could aid in orthodontic diagnosis and treatment planning. **Purpose:** The purpose of this study was to determine the following: 1.The prevalence of impacted mandibular second molars in Hispanic orthodontic subjects. 2. If there are differences in frequency and distribution (unilateral or bilateral) of mandibular second molar impaction in male versus female Hispanic orthodontic subjects. 3. The clinical significance of the angle of inclination between the first and second molars MM2 impaction. 4. The clinical significance of reduced arch length between the distal height of contour of the mandibular first molar and the anterior margin of the mandibular ramus in mandibular second molar impaction. **Methods:** This study was conducted retrospectively at the Herman Ostrow School of Dentistry of USC Department of Orthodontics. A digital imaging database (Dolphin) containing 6,217 patient records was examined alphabetically. Cases were selected for the study based on a set of selection criteria. The age and ethnicity criteria narrowed the pool of eligible records and patients with impacted MM2s were identified. The angle of inclination of the impacted MM2, as well as the distance from the distal height of contour of the first mandibular molar (MM1) to the anterior margin of the mandibular ramus, were measured on the panoramic radiographs. **Results:** Of the 1,799 records reviewed, 75 patients were found with 96 impacted MM2s (30 males and 45 females, sex ratio 1:1.5) with an age range 11.1 to 18.10 years. The prevalence in this sample was 4.2%. Unilateral impactions were more common (72%) than bilateral impactions (28%). Males were more likely to have bilateral impactions and

females were more likely to have unilateral impactions. Bilateral MM2 impactions had more severe angles of inclination than unilateral MM2 impactions. **Conclusion:** The prevalence (4.2%) of MM2 impaction in Hispanics is higher than other populations represented in the literature. Impacted MM2s have a significantly ($p=.001$) higher angle of inclination than non-impacted MM2s. If the angle of inclination of an MM2 is more than 20 degrees to the MM2 there is a 90% change it will become impacted. Bilateral MM2 impactions had more severe angles of inclination than unilateral MM2 impactions. The distance from the distal height of contour of the MM1 to the anterior margin of the mandibular ramus was not clinically significant in predicting or diagnosing MM2 impaction in Hispanics.

Poster #: 39

Title: Orthodontic three-dimensional era: past, present, and future of digital technology
Name: Nicole Starkey
Faculty Advisor: Glenn Sameshima

Background: Dentistry and orthodontics in particular has undergone a major shift over the past decade. Three-dimensional diagnostic tools and treatment planning modalities have changed the field drastically as orthodontists are incorporating new materials and innovative technologies into their practices and everyday procedures. The use of digital technology also meets the demand of patients' preferences towards more technologically advanced treatment approaches. **Purpose:** The objective of this article was to review the three-dimensional innovations used in dentistry, especially orthodontics. Various intra-oral scanners and extra-oral scanners are described in depth, with explanations of the technology used in each. Three-dimensional printing or additive manufacturing is also explained, especially focusing on 3D printing in orthodontics as used with orthodontic study models and clear aligner treatment. The future of orthodontics as it pertains to 3D technology is also depicted. **Methods:** N/A **Results:** N/A **Conclusion:** Three-dimensional technologies have changed diagnosis and treatment planning in orthodontics, allowing increased patient comfort and more efficient-

ly run orthodontic practices. In the future, 3D technologies will continue to evolve and most orthodontic practices will phase out their 2D diagnostic techniques while fully adopting 3D technology.

Poster #: 40

Title: Comparing lateral cephalometric and condyle position changes following orthognathic surgery
Name: Heather Stephens
Faculty Advisor: Dan Grauer

Background: During orthognathic surgery, regions of the craniofacial complex are altered in all three dimensions. The upper jaw, lower proximal segment and bilateral distal segments must be separated, reoriented and then secured in the desired position. During surgery, changes in position of both condyles and the midsagittal face occur. **Purpose:** To evaluate the relationship between midline lateral cephalometric landmark changes with condylar translation and rotation displacement following bi-maxillary surgery. **Methods:** On pre- and 2 weeks post-surgery cone beam computed tomography (CBCT) scans, post-surgical condyle translation and rotation values were measured for 32 patients. Each pair of condyles was reoriented to the glenoid fossa, superimposed and then cropped to the same size. Lateral cephalometric images were oriented to NHP and traced to identify several anatomic midline landmarks. The linear or angular change between the pre- and post-surgical landmarks was analyzed for statistical significance. The condylar translation and rotation changes were then compared to the post-surgical lateral cephalometric changes. **Results:** Lateral cephalometric landmark samples for SNA, SNB, AFH, SN-GoGn and Occl-SN were all statistically significantly ($p<0.05$), while PFH was not significant. A proxy value was used for condyle translation and rotation in order to compare condyle movement to cephalometric post-surgical change. No significant correlation was found between lateral cephalometric midline landmarks and age, gender, condyle rotation, or condyle translation. **Conclusion:** Patients who present with skeletal deformity that requires surgical correction have a variety of factors that contribute to post-surgical condyle and

skeletal positions. A much larger sample size/more statistical power is needed to detect relationships between condyle and midline landmark changes accurately.



Poster #: 41

Title: Implant-to-tooth spatial relationship and marginal bone loss
Name: Azadeh Tavari
Faculty Advisor: Homa Zadeh

Background: Current literature recommends a certain horizontal distance between a natural tooth and the adjacent implant in order to avoid marginal bone loss on the implant; however, little is known on the possible effect of horizontal proximity of dental implants on the attachment level of the natural tooth. **Purpose:** The objective of the present retrospective study was to determine whether the 3D spatial relationship between an implant and adjacent natural tooth is associated with their respective marginal bone levels. **Methods:** This multi-centered retrospective study included patients who had received implants adjacent to natural teeth at the University of Southern California Dental Clinic or a private periodontal office. Inclusion criteria consisted of: 1. The presence of an implant adjacent to a natural tooth; 2. Availability of diagnostic quality radiographs at time of implant installation and at least one year post implant placement. Parameters of interest included: horizontal distance between the implant and natural tooth, distance between the implant platform and adjacent cemento-enamel junction (CEJ), change in marginal bone level (MBL) on the implant (relative to implant platform) and tooth relative to CEJ. Linear measurements of the radiographic images were calibrated and analyzed using Photoshop software. Statistical analysis included the Pearson correlation coefficient to calculate the

relationship between the horizontal discrepancies and MBL. **Results:** This study included 64 patients with a mean age of 61 years old, encompassing 123 implants of four different implant systems with the mean follow up period of 51 months. Radiographs were obtained at implant placement, crown installation and the last follow-up. The data were analyzed with respect to implant/tooth units, and Pearson correlation test was used to evaluate the association between horizontal discrepancy and marginal bone loss at proximal surfaces of adjacent implants and teeth. The mean tooth-implant horizontal level distance was 3.76mm at the mesial and 3.10mm at the distal aspect of implants. The average peri-implant bone loss after implant placement at the mesial surface of the distal implants and at the distal surface of the mesial implants was 1.09 mm and 0.99 mm, respectively. The average marginal bone loss after implant placement at the mesial surface of the mesial implants and at the distal surface of the mesial adjacent tooth was 1.95mm and 0.53mm, respectively. Correlation test failed to detect significant correlation between the horizontal level discrepancy and marginal bone loss on the adjacent tooth ($P=.932$), but showed a statistically significant correlation at the mesial surface of the mesial implant ($P=0.01$). **Conclusion:** Based on our current available data, a significant correlation between horizontal discrepancy and marginal bone loss of implants was detected.

Poster #: 42

Title: Efficacy of chlorhexidine for prevention and treatment of oral mucositis
Name: Amir Balouch
Faculty Advisor: Reyes Enciso

Background: Oral mucositis occurs in patients undergoing chemoradiation for cancer treatment. It is believed that colonization of ulcerated mucosa by bacteria, fungi, and viruses results in secondary infections. The effect of chlorhexidine on the incidence and severity of oral mucositis in patients with cancer was evaluated in this review. **Purpose:** In head & neck cancer patients with oral mucositis after radiation therapy/chemotherapy, what is the effect

of antimicrobials on reduction of pain intensity and severity of mucositis compared with placebo and/or other treatments? **Methods:** Studies were limited to randomized placebo-controlled trials. Three databases were searched: MEDLINE (via PubMed), Web of Science, and the Cochrane Library up to May 25, 2016. **Results:** Ninety-eight abstracts were evaluated by three independent reviewers. Twelve studies met the criteria for inclusion. Four of these studies were assessed at unclear risk of bias and eight of them at high risk. Of the 12 studies, nine were included in two meta-analyses. Pooled results showed that chlorhexidine did not significantly reduce incidence of mucositis compared to placebo ($P = 0.129$), nor did chlorhexidine significantly reduce the severity of mucositis ($P = 0.127$), although subgroup analysis in the chemotherapy group showed a trend toward significance ($P = 0.054$). **Conclusion:** This systematic review found that chlorhexidine is not significantly effective in reducing the severity of mucositis (moderate quality of evidence) nor in preventing the incidence of mucositis (low quality of evidence). However, more studies are needed in patients receiving chemotherapy only, as a positive trend toward significance was found ($P = 0.054$).

Poster #: 43

Title: CBCT of condylar displacement post-orthognathic surgery
Name: Bethany Chong
Faculty Advisor: Dan Grauer

Background: Orthognathic surgical relapse related to condylar change has been studied since it was first acknowledged in the early 1980's using two dimensional radiographic modalities. 2-D imaging provides inherent limitations because it lacks the third dimension of depth and thus cannot fully depict condylar changes. With the advent of cone-beam computed tomography (CBCT), condylar displacement can be quantified in three planes of space post-orthognathic surgery and provide valuable information in the long-term followup of surgical stability. **Purpose:** To quantify in 3-D the condylar displacement 2 weeks after 2-jaw surgery using the glenoid fossa as a stable ref-

erence structure. **Methods:** The sample consisted of 15 patients undergoing orthognathic surgery performed by one surgeon in a consecutive manner. The pre-surgical and 2-week post-surgical CBCT Digital Imaging and Communications in Medicine (DICOM) files were collected for each patient and the temporomandibular joint (TMJ) complex was segmented. The pre- and post-surgical condyles were superimposed using the glenoid fossa as the stable reference structure. Condylar translation and rotation of the post-surgical condyles were recorded in three planes of space (x, y, z). **Results:** The average condylar displacement was 0.045 mm on the x-plane, -0.39 mm on the y-plane, and 0.01 mm on the z-plane. As for rotation, the average movement was -0.68 mm on the x-plane, 1.66 mm on the y-plane, and -2.43 on the z-plane. The greatest displacements were translation in the y plane and rotation on the z-plane. The movements that were statistically significant were translation on the x-plane and rotation on the z-plane ($p<0.008$). **Conclusion:** The results of this study refer to immediate post-surgical findings and a 12 month follow-up with increased sample size and appropriate 3-D superimpositioning methods can further aid in identifying whether the surgical movements explain long-term stability and/or condylar resorption. Also factors such as abnormal anatomy and previous condylar resorption prior to surgery should be evaluated as potential contributors to long-term stability.

GRADUATE POST-DOCTORAL TRAINEES

Poster #: 44

Title: Integration and expression of beta-galactosidase in *Aggregatibacter actinomycetemcomitans*
Name: Eduardo Ayala
Faculty Advisor: Casey Chen

Background: Gram-negative *Aggregatibacter actinomycetemcomitans* (*Aa*) is a major etiological agent of periodontitis. Conventional gene expression reporter constructs are often made in extrachromosomal vectors, which

may be dependent on selective agents to maintain their stability. This requirement often precludes the use of reporter gene constructs in experiments that involve co-culture of multiple microbial species. **Purpose:** As a proof of principle, we designed a stable genome-integrated beta-galactosidase construct in *Aa*. **Methods:** A non-functional secA pseudogene in the genome of *Aa* strain D7S-1 was chosen as the insertion site for the reporter. The construct consisted of the upstream region of secA, a transcriptional terminator sequence, two test promoters (ltx and fim), a beta-galactosidase coding sequence (CDS), a spectinomycin resistance cassette, and the downstream region of secA. These fragments were cloned into pUC19 and then used as a template for PCR. This amplified donor DNA was then used for natural transformation of *Aa*. Transformants were screened by PCR and verified by sequencing and X-gal cleavage. A promoterless negative control was generated by linking the transcriptional terminator directly to the beta-galactosidase CDS. **Results:** Two beta-galactosidase-expressing *Aa* strains were made, driven by either a JP2 type leukotoxin promoter or a fimbrial protein promoter, as well as a promoterless negative control. Both the ltx- and fim-driven reporter strains were found to exhibit beta-galactosidase activity as detected by visual examination of X-gal cleavage on agar plates and through luminescence using the Beta-Glo Luciferase Assay System, while the negative control exhibited no beta-galactosidase activity. **Conclusion:** Our results show that our genetic manipulation strategy results in a stably integrated construct and may prove useful for gene expression studies in *Aa*.

Poster #: 45

Title: Cx43 increased expression in stromal cells promotes leukemia apoptosis.
Name: Xuelian Chen
Faculty Advisor: Jiang Zhong

Background: Connexin 43 (Cx43) induced apoptosis has been reported in solid tumors, but the effect of Cx43 expressed by bone marrow stromal cells (BMSC) in leukemia has not been fully investigated. Manipulating Cx43

expression could be a potential therapeutic strategy for leukemia. **Purpose:** Here, we investigate the effect of Cx43 expressed by BMSCs (human Umbilical Cord Stem Cells over-expressed CX43, Cx43-hUCSC) on leukemia cells. **Methods:** We used fluorescence recovery after photo bleaching (FRAP) and Cx43-hUCSC and leukemia cell co-culture to evaluate the functional status of intracellular gap junction communication in leukemia cells. In a mouse model of minimal residual disease, we assessed the mean survival time and mortality rate of animals transplanted with Cx43-hUCSC. **Results:** We showed improved gap junctional intercellular communication (GJIC) in leukemia cells when co-cultured with Cx43-hUCSC. Leukemia cells showed a significantly lower growth rate with increasing apoptosis activity, and more leukemia cells entered S phase. In a mouse minimal disease model, the mean survival time and mortality rate were significantly improved in mice transplanted with Cx43-hUCSC. **Conclusion:** Our results indicate that Cx43 expressed by BMSC induces apoptosis in leukemia cells. Small molecules or other pharmaceutical approaches for modulating Cx43 expression in BMSCs could be used for delaying relapse of leukemia.

Poster #: 46

Title: Twist1 and Tcf12: regulators of postnatal sutural stem cell microenvironment
Name: Devon Ehnes
Faculty Advisor: Yang Chai

Background: Craniosynostosis is a condition in which the sutures in the infant skull prematurely fuse. One of the most common genetic causes is mutation in the transcription factor *Twist1*. Previous studies have indicated that *Twist1*^{-/-} mice show suture defects as early as E12.5. Zhao and colleagues (2015) showed the cranial suture serves as a stem cell niche and that sutural stem cells were depleted when Twist1 was mutated. Sharma and colleagues (2013) demonstrated that another transcription factor, Tcf12, was also commonly mutated in craniosynostosis. They demonstrated that Tcf12 and Twist1 act synergistically: mice with heterozygous mu-

tations for both Tcf12 and Twist1 developed severe craniosynostosis. We aim to identify the molecular factors regulated by Twist1-Tcf12. **Purpose:** To understand the role of Twist1 and Tcf12 in the postnatal suture microenvironment and to identify binding sites that they co-regulate. **Methods:** To determine whether Tcf12 and Twist1 are required for stem cell maintenance or differentiation, we will perform lineage tracing using *Twist1* and *Tcf12* mutants crossed with *Gli1-Cre;tdTomato* reporter mice. To identify Twist1 binding sites that are either Tcf12 dependent or independent, we will generate Twist1-FLAG tagged and Tcf12-HA tagged mutant mice. We will cross these mice with *Gli1-Cre;tdTomato* reporter mice and perform ChIP-Seq on tdTomato+ cells. **Results:** We are currently generating the mutant mice to perform these experiments. **Conclusion:** This study will advance the molecular understanding of craniosynostotic diseases such as Saethre-Chotzen syndrome.

Poster #: 47

Title: BMP signaling orchestrates mesenchymal cell fate via a transcriptional network
Name: Jifan Feng
Faculty Advisor: Yang Chai

Background: Mesenchymal stem cells (MSCs) are multipotent progenitor cells that undergo strict lineage-specific differentiation programs, faithful to their unique tissue origins. The apical region of immature human teeth contains a distinct mesenchymal stem cell (MSC) population, namely stem cells of the apical papilla (SCAPs), which is potentially crucial for root formation during postnatal tooth development. Because BMP signaling is an important regulator of early tooth development and odontogenic differentiation of dental mesenchymal stem cells *in vitro*, we hypothesize that BMP signaling may also regulate apical papilla stem/progenitor cells to undergo odontogenic differentiation. **Purpose:** In this study, we used tooth root development as a model to investigate how the BMP signaling pathway regulates specific downstream transcriptional complexes to direct the fate determination of multipotent MSCs. **Methods:** We first investigated

the *in vivo* identity of SCAPs and their relationship with BMP signaling during root development. We then disrupted BMP signaling in the apical mesenchymal cells utilizing a transgenic mouse model to investigate how BMP signaling activates SCAPs into their odontogenic differentiation program. **Results:** We identified the MSC population supporting mouse molar root growth as Gli1+ cells and found that BMP signaling activity is required for the activation of MSCs into their differentiation program. In addition, we identified transcription factors as downstream targets of BMP that may regulate the odontogenic mesenchyme lineage program by activating odontogenesis, such as Klf4. Loss of Bmp signaling leads to an altered pattern of Klf4 and other downstream targets, suggesting that Bmp signaling may fine-tune the spatial distribution of this signaling network. **Conclusion:** Our results demonstrate that BMP signaling regulates the *in vivo* odontogenic lineage commitment of MSCs during tooth morphogenesis via a transcriptional network. Moreover, our results demonstrate that murine tooth development offers an excellent *in vivo* model for studying mesenchymal stem cells.



Poster #: 48

Title: Generation and characterization of tamoxifen-inducible *Pax9-CreER* knock-in mice using CrispR/Cas9
Name: Jifan Feng
Faculty Advisor: Yang Chai

Background: *Pax9* encodes a paired-box homeodomain transcription factor and is critical for the development of multiple organs. Pax9 expression also marks sites of prospective tooth development before morphological signs of odontogenesis appear, and is maintained in the developing embryonic tooth mesenchyme.

Purpose: To generate *Pax9-CreER* knock-in mice for lineage tracing and genetic targeting of *Pax9*-expressing cells and their progeny. **Methods:** Using CrispR/Cas9-mediated homologous directed repair, we generated a new *Pax9-CreER* knock-in mouse line in which the CreER^{T2} fusion protein is produced after synthesis of endogenous Pax9 protein. We integrated the 2A-CreER^{T2} coding sequence into the last exon of *Pax9*, immediately before the stop codon, in-frame. As a result, CreER expression is regulated by the *Pax9* promoter in tandem with endogenous *Pax9* expression. To detect the insertion of *CreER^{T2}* into the *Pax9* gene, we designed PCR primers to target the altered DNA fragments spanning the *Pax9* gene outside the left homology arm and the CreER cassette inside the donor construct. We identified one mouse from 24 littermates that contained mutant PCR products consistent with the presence of the CreER cassette in the 3' end of the *Pax9* gene. **Results:** We found that tdTomato reporter expression in *Pax9-CreER;tdTomato* reporter mice faithfully recapitulates the *Pax9* expression domains throughout the embryo and in the adult mouse. At early embryonic stages, the tdTomato reporter is expressed first in the pharyngeal pouch region and later in the craniofacial mesenchyme, somites, limbs, and lingual papillae in the adult tongue. **Conclusion:** This new mouse line can be used for lineage tracing and genetic targeting of *Pax9*-expressing cells and their progeny in a temporally and spatially controlled manner during development and organogenesis.

Poster #: 49

Title: The role of PRMT1 in craniofacial development
Name: Yongchao Gou
Faculty Advisor: Jian Xu

Background: Protein arginine methyltransferases 1 (PRMT1) catalyzes asymmetric arginine methylation of proteins, which regulate pre-mRNA splicing, DNA damage signaling, mRNA translation, cell signaling, and cell fate decision. PRMT1 is known to methylate SMAD6, SMAD7 and AXIN, therefore it can regulate the BMP/TGF-beta and WNT signaling pathways and modulate

craniofacial development through regulation of BMP/TGF-beta and WNT signaling pathways. **Purpose:** We hypothesized that PRMT1 regulates craniofacial development. **Methods:** Conditional gene knock-out, Western blots, immunofluorescence staining, immunohistochemistry staining, HE staining, Micro-CT. **Results:** Conditional knock-out of Prmt1 in neural crest cells led to a smaller head and complete cleft palate, but the ossification of craniofacial bone was not inhibited. The migration of neural crest cells was not affected. Palatal shelves failed to elevate and face each other at E14.5, however they could elevate after removing the mandible and tongue in organ culture. Proliferation of palate mesenchymal cells was reduced, meanwhile the apoptosis was not affected. Beta-catenin was significantly increased in palate mesenchymal cells. **Conclusion:** PRMT1 is necessary for craniofacial development. Deletion of Prmt1 stabilizes beta-catenin and enhances nuclear beta-catenin level. We propose that overactivation of beta-catenin led to insufficient proliferation of palatal mesenchymal cells and premature differentiation therefore causing cleft palate.

Poster #: 50

Title: PRMT4-mediated methylation of RUNX2 regulates cell migration and invasion
Name: Yongchao Gou
Faculty Advisor: Jian Xu

Background: RUNX2 is an important factor in osteoblast differentiation and bone development. It also regulates mammary gland development and mammary cancer. Overexpression of Runx2 leads to a more invasive phenotype in breast cell lines, meanwhile knockdown of Runx2 decreases invasiveness. Post-translational modification of RUNX2, including phosphorylation, ubiquitination and methylation, regulates its function. We identified RUNX2 methylation at arginine motifs by the protein arginine methyltransferase PRMT4 and determined the function of RUNX2 arginine methylation in breast cancer cell migration and invasion. **Purpose:** We hypothesized that PRMT4 methylates RUNX2 and regulates its function in breast cancer cell

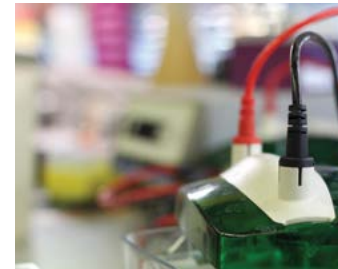
migration and invasion. **Methods:** Cell culture, western blots, immunofluorescence staining, *in vivo* methylation and *in vitro* methylation. **Results:** We identified that RUNX2 is methylated by PRMT4 both *in vivo* and *in vitro* on four arginine residues. Wild-type Runx2 stimulated NMuMG cell migration and invasion while mutant Runx2 (arginine mutation) lost the pro-migratory and pro-invasive function. **Conclusion:** Arginine methylation of RUNX2 via PRMT4 plays an important role in breast cancer cell migration and invasion, suggesting that arginine sites of Runx2 could be a novel target for cancer treatment.

Poster #: 51

Title: Bmpr1a deletion in Gli1+ cells disrupts homeostasis of the suture
Name: Yuxing Guo
Faculty Advisor: Yang Chai

Background: Sutures function as the growth centers for bone formation, allowing growth of the skull bones to accommodate expansion of the brain during fetal and postnatal development. Craniosynostosis is a developmental disorder in which sutures fuse prematurely, possibly as the result of defects in suture stem cells. Gli1+ cells within the suture mesenchyme represent the main mesenchymal stem cell (MSC) population for craniofacial bones. Loss of Bmpr1a affects homeostasis in different systems, such as the intestine, hair follicle and osteogenic tissues, but the role of BMPR1a in suture homeostasis remains unclear. **Purpose:** To investigate the function of Bmpr1a in suture stem cells. **Methods:** We investigated the function of Bmpr1a during suture homeostasis using mice in which Bmpr1a is conditionally deleted in Gli1+ cells (*Gli1CreERT2;Bmpr1a^{lox/flox}* mice). We analyzed the phenotype of these mice using microCT, H&E staining and immunofluorescence. **Results:** After loss of Bmpr1a in Gli1+ suture stem cells, the sagittal suture became narrower and nearly fused in *Gli1CreERT2;Bmpr1a^{lox/flox}* mice one month after tamoxifen induction. In addition, we detected an increase in cell proliferation and apoptosis activity in the sutures of mutant mice. Moreover, FGF2, FGFR2 and β -catenin expression was increased in the sutures of

mutant mice. **Conclusion:** Loss of Bmpr1a in Gli1+ suture stem cells resulted in a defect in suture homeostasis and the inability of the sutures to remain patent. Cellular mechanisms for this defect may include increased cell proliferation and apoptosis activity and upregulation of FGF2, FGFR2 and β -catenin expression levels.



Poster #: 52

Title: Distinct differentiation capacities of mesenchymal stem cells from different origins
Name: Summer Xia Han
Faculty Advisor: Yang Chai

Background: The origins and skeletogenesis of facial bones are different from that of appendicular bones. Previous studies have shown that cranial neural crest-derived mandible MSCs (CNCCMSC) have a greater osteogenic capacity than mesoderm-derived bone marrow MSCs (BMMSC) from long bones. In this study, we investigate the regulatory mechanisms underlying this phenomenon. **Purpose:** To investigate the regulatory mechanisms underlying the distinct differentiation capabilities of mesenchymal stem cell (MSC) populations from different origins. **Methods:** We performed RNA-seq of CNCCMSCs and BMMSCs from *Wnt1-cre;tdTomato* mice. In order to understand the regulation of the differential gene expression, we will also perform ChIPseq and motif analysis to characterize the landscape of gene regulatory elements. **Results:** We have performed cell sorting to isolate BMMSCs from femurs of 8 weeks old *Wnt1-cre;tdTomato* mice, using CD45 and CD31 as negative selectable markers to eliminate hematopoietic cells. CNCCMSCs were similarly isolated from mandibles of the same group of mice, using WNT1 as an additional positive selectable marker. We have performed RNA-seq to identify differentially expressed genes. We are currently analyzing

our RNA-seq data for genes and pathways that differ between the two populations of cells. **Conclusion:** This study will contribute to our understanding of how MSCs from different origins give rise to distinct differentiation capacities and may lead to the development of better strategies for different types of bone regeneration.

Poster #: 53

Title: Protein methylation in epithelial-to-mesenchymal transition of epicardial cells.
Name: Olan Jackson-Weaver
Faculty Advisor: Jian Xu

Background: The epithelial to mesenchymal transition (EMT) is an important cellular mechanism in diverse biological processes such as development, wound healing, cancer metastasis, and fibrosis. We focus on epicardial cells, for which EMT is a key mechanism in activation and differentiation. Epicardial cells are mesothelial cells lining the heart. They are important progenitors that give rise to cardiac fibroblasts and smooth muscles and a source of growth factors. Our recent work has established an important function for the protein arginine methyltransferase PRMT1 in EMT. **Purpose:** We tested the hypothesized that PRMT1 is required for EMT in epicardial cells. **Methods:** Cell culture, western blots, real-time PCR, siRNA, embryo culture, Cre-lox technology. **Results:** We found that silencing PRMT1 in epicardial cells prevented EMT protein changes and the migratory and invasive phenotypes that are characteristic functional outcomes of EMT. Silencing PRMT1 increased levels of p53 by reducing p53 turnover. Decreasing p53 expression, on the contrary, increased the induction of the mesenchymal factor Slug during EMT. Furthermore, silencing PRMT1 also inhibited epicardial EMT *ex vivo* in an embryo thorax culture model. Epicardial deletion of PRMT1 in *WT1CreERT;PRMT1^{lox/flox};YFP^{fl}* mice also prevented epicardial EMT and reduced ventricular compact zone thickness. **Conclusion:** PRMT1-p53 pathway controls epicardial EMT. These studies establish a role for protein methylation in the EMT process and could lead to treatments for diseases affected by EMT.

Poster #: 54

Title: Dynamic interaction between TA cells and MSCs in tissue homeostasis
Name: Junjun Jing
Faculty Advisor:

Background: The mouse incisor provides an excellent model for studying mesenchymal stem cell (MSC) and TA (transit amplifying) cell interaction. Our previous studies have demonstrated that Gli1+ perivascular cells are typical MSCs *in vivo*. **Purpose:** We use multiple approaches to study the dynamic interaction between MSCs and TA cells during mesenchymal tissue homeostasis. **Methods:** Multiple transgenic animal models were generated in this study: *Gli1-CE;Beta-catenin^{fl/fl}* and *Gli1-CE;Beta-catenin^{fl/fl};Gli1-LacZ* mice; *Axin2-CE;tdTomato* mice; *Axin2-CE;Wntless^{lox/flox}* and *Axin2-CE;Wntless^{lox/flox};Gli1-LacZ* mice; *Axin2-CE;Beta-catenin^{lox/flox}* and *Axin2-CE;Beta-catenin^{lox/flox};Gli1-LacZ* mice. CT scanning and histological analysis were performed to analyze the phenotypes of these mice. **Results:** We found that canonical Wnt signaling regulates the MSC to TA cell transition in the mouse incisor because TA cells are undetectable in *Gli1-CE;Beta-catenin^{fl/fl}* mice after one week of tamoxifen (TM) injection. Lineage tracing experiments demonstrated that Axin2+ cells are at least a subpopulation of TA cells in mouse incisors. In addition, there are no TA cells in *Axin2-CE;Wntless^{lox/flox}* mice after three weeks of TM injection, suggesting that Axin2+ TA cells are regulated via an autocrine Wnt signaling feedback loop. Moreover, there is feedback from Axin2+ TA cells to Gli1+ MSCs in the mouse incisor because Gli1+ MSCs are reduced after TA cell loss in *Axin2-CE;Wntless^{lox/flox};Gli1-LacZ* and *Axin2-CE;Beta-catenin^{lox/flox};Gli1-LacZ* mice. **Conclusion:** Axin2+ TA cells are regulated via an autocrine Wnt signaling feedback loop and Axin2+ TA cells and Gli1+ MSCs interact dynamically during mesenchymal tissue homeostasis.

Poster #: 55

Title: Remineralization effects on resin-dentin bond strength

Name: Adriana Lemos Mori Ubaldini do Amaral
Faculty Advisor: Pascal Magne

Background: Mineral deposition resulting from dentin remineralization may enhance the durability of the resin–dentin bonds due to the protection function of intrafibrillar apatites on collagen. **Purpose:** This study evaluated the remineralization effect on the resin-dentin interface. The null hypothesis to be tested was that the use of bioactive agents employed during bonding procedures has no effect on dentin bond strength. **Methods:** Thirty dentin discs (8x8x5mm) were divided into 3 groups (n=10): G1) control group; G2) Bioglass 45S5 remineralized group; G3) Biosilicate remineralized group. Dentin hybridization was performed with a two-step etch-and-rinse adhesive (Optibond S- Kerr, Orange, CA, USA). Remineralization process of G2 and G3 was done after acid conditioning through the active application of bioactive solution (0.015g of the specific agent powder diluted in 1.35ml of distilled water) at dentin for 30 seconds. After adhesive treatment, five 1mm-thick increments of a resin composite were built up at the dentin surface and then the specimens were subjected to microtensile bond strength test (µTBS). Specimen's fractured modes were observed with a scanning electron microscope (SEM). µTBS values were submitted to ANOVA and post-hoc Tukey-Kramer tests (p≤0.05). **Results:** The null hypothesis must be totally rejected as high µTBS values were achieved in groups G2 (78.5 MPa+15.2) and G3 (73.7 MPa+14.8) when compared to G1 (58.9 MPa+11.8) (p≤0.05). SEM analysis showed that failure modes were prevalently adhesive, G1 (35.7%), G2 (40%) and G3 (35.5%). **Conclusion:** Remineralization treatment with Bioglass 45S5 and with Biosilicate increased dentin bond strength, indicating that mineral deposition within the hybrid layer improved the resin-dentin bond.

Poster #: 56

Title: Constitutive activation of SHH in the epithelium causes submucous cleft palate
Name: Jingyuan Li
Faculty Advisor: Yang Chai

Background: Palatal fusion is a complex, multi-step developmental process; the consequence of failure in this process is cleft palate, one of the most common human birth defects. Cleft palate is associated with multiple genetic and environmental risk factors. Mutations in the genes encoding signaling molecules in the Sonic Hedgehog (SHH) pathway, such as SHH and PTCH, have been identified as genetic risk factors for cleft palate in both humans and mice. However, the function of SHH signaling activity in the palatal epithelium during the fusion process remains largely unknown. **Purpose:** To investigate the function of SHH signaling activity in the palatal epithelium during the fusion process. **Methods:** Previous studies have shown that specific inhibition of SHH signaling activity in the palatal epithelium does not affect palatal fusion. Here, we constitutively activated SHH signaling in the palatal epithelium by generating *K14Cre;R26SmoM2^{fl/+}* mice. **Results:** In this study, we found that constitutive activation of SHH signaling in the palatal epithelium caused submucous cleft, soft palate cleft and failure of the primary palate to fuse with the secondary palate. Similar to a zona pellucida, characteristic of human submucous cleft, a shining transparent strip was also detectable on the posterior part of the midline in mutant palate at newborn stage. Further analysis revealed a persistent medial edge epithelium (MEE) with continuous proliferation and an epithelial bridge in the midline of mutant palate. At the molecular level, constitutive activation of SHH resulted in the maintenance of Sox2+ cells in the MEE. Meanwhile, we found that *K14Cre;Rosa26-Sox2^{fl/+}* mice, with constitutively activated Sox2 expression in the palatal epithelium, phenocopied *K14Cre;R26SmoM2^{fl/+}* mice, with a persistence of the MEE. **Conclusion:** Taken together, we conclude that SHH signaling in the palatal epithelium plays a critical role during palatal fusion by regulating the fate of the medial edge epithelium.

Poster #: 57

Title: Identify a genetic mutation in clear cell renal cell carcinoma
Name: Qin Ran
Faculty Advisor: Jiang Zhong

Background: Metastasis is the major cause of death among clear cell renal cell carcinoma patients, yet early detection and intervention of metastasis could significantly improve their clinical outcomes. **Purpose:** Early detection and intervention of metastasis for improving clinical outcomes of clear cell renal cell carcinoma. **Methods:** We have sequenced and analyzed RNA (expression) and DNA (mutations) from the primary tumor (PT), tumor extension (TE) and lymphatic metastatic (LM) sites of patients with clear cell renal cell carcinoma (CCRCC) before treatment. **Results:** Here, we report a three-nucleotide deletion near the C-region of PLK5 that is specifically associated with the lymphatic metastasis. This mutation is undetectable in the PT, becomes detectable in the TE and dominates the LM tissue. So while only a few primary cancer cells carry this mutation, the majority of metastatic cells have this mutation. The increasing frequency of this mutation in metastatic tissue suggests that this PLK5 deletion could be used as an early indicator of CCRCC metastasis and be identified by low cost PCR assay. **Conclusion:** A large scale clinical trial could reveal whether a simple PCR assay for this mutation at the time of nephrectomy could identify and stratify high-risk CCRCC patients for treatments.

Poster #: 58

Title: Characterization of the bent bone dysplasia conditional knock-in mouse
Name: Diana Rigueur
Faculty Advisor: Amy Merrill

Background: Fibroblast growth factor receptor 2 (FGFR2) regulates osteoprogenitor proliferation, self-renewal and terminal differentiation during skeletal development, yet it remains unclear how the receptor distinctly elicits these cellular processes. We discovered a nuclear feature of FGF signaling that will elucidate with more specificity how FGFR2 regulates skeletal development. This mechanism emerged from our analysis of bent bone dysplasia syndrome (BBDS), an FGFR2-disorder where the cell fate decisions of osteoprogenitor cells are biased towards self-re-

newal over differentiation. **Purpose:** The purpose of the study is to understand the breadth of roles cell nuclear fibroblast growth factor receptor 2 (FGFR2) plays in craniofacial skeletal development and pathogenesis. **Methods:** We developed a mouse with a conditional knock-in of the *Fgfr2* M391R mutation. Primary chondrocytes were isolated from *fx/fx* rib cages and treated with or without Adeno-GFP or Adeno-Cre. DNA was isolated from samples and sequenced to assess whether the floxed allele could recombine. Immunofluorescence of FGFR2 was conducted in the subsequent set of cells and tested for nuclear translocation of FGFR2. The dominance of the expressed allele was tested by conducting a cross between a *Wnt1-Cre* expressing male and a *Fgfr2-M391R^{fx/+}* female. Alcian blue and alizarin red skeletal preparations of the skulls of the progeny (P3,P21) were conducted and analyzed. MicroCT images of the skulls were taken and analyzed for differences in skull anatomy and calcium deposition. **Results:** We developed a mouse with a conditional knock-in of the *Fgfr2* M391R mutation that causes BBDS in humans. DNA sequencing of cultured primary chondrocytes treated with Adeno-GFP or Adeno-Cre confirmed efficient Cre-mediated recombination of the knock-in allele. Cell culture experiments and immunofluorescence further showed that the knock-in *Fgfr2*^{M391R} allele functions like that of BBDS, aberrantly translocating FGFR2 to the nucleus. Moreover, the phenotype in neural crest derived tissues strongly suggests that the mutation is dominant in mouse as it is in humans. **Conclusion:** Overall our preliminary data shows that the conditional knock-in *Fgfr2*^{M391R} mouse can be used to model human BBDS and can also be used to parse out the unknown endogenous and pathogenic functions of nuclear FGFR2.

Poster #: 59

Title: Adding MMP20 to amelogenin-chitosan hydrogel improves biomimetic enamel repair
Name: Qichao Ruan
Faculty Advisor: Janet Moradian-Oldak

Background: We recently demonstrated that an amelogenin-chitosan

(CS-AMEL) hydrogel is effective at forming an enamel-like layer on etched tooth surfaces with a robust interface. However, the mechanical properties of newly grown layers were compromised by the presence of organic materials. We further showed that matrix metalloproteinase-20 (MMP20) plays a critical role in preventing protein occlusion inside enamel crystals. **Purpose:** To test our hypothesis that addition of MMP20 to CS-AMEL hydrogel could reinforce the newly grown layer by preventing amelogenin occlusion inside apatite crystals. Our aims were i) to analyze the proteolytic processing of amelogenin by MMP20 in the presence of chitosan, and ii) to synthesize an enamel-like layer on etched enamel by applying the MMP20-containing (MMP20-CS-AMEL) hydrogel. **Methods:** rhMMP-20 was added to the CS-AMEL hydrogel (Protein:MMP20ratio = 1000:1) along with ZnCl₂ solution (20µM). The etched enamel was treated with MMP20-CS-AMEL or CS-AMEL hydrogel as control and then immersed in artificial saliva solution at 37°C. The MMP20 proteolysis of amelogenin was studied by high performance liquid chromatography and gel electrophoresis. The morphology and composition of products were characterized using scanning electron microscopy, X-ray diffraction and Fourier transform infrared spectroscopy. The mechanical properties of the newly grown layer were measured by nanoindentation. **Results:** Amelogenin was gradually degraded by MMP20 in the presence of chitosan. The newly grown crystals in the sample treated with MMP20-CS-AMEL hydrogel showed more uniform orientation, higher crystallinity and a greater length-to-thickness ratio than the samples treated with CS-AMEL hydrogel without MMP-20. The amount of protein observed in the repaired enamel was decreased by the addition of MMP20. Both the modulus and hardness of repaired enamel were significantly improved by the MMP20-CS-AMEL hydrogel. **Conclusion:** Addition of MMP20 to CS-AMEL hydrogel improved the mechanical properties of a newly grown enamel-like layer by regulating crystal growth and preventing protein occlusion.



Poster #: 60

Title: HIV healing outcomes
Name: Erika Sequeira
Faculty Advisor: Thomas Levy

Background: Indirect determination of viral presence in healing periapical lesions. **Purpose:** Evaluate healing outcomes of non HIV Patients with HIV+ patients. **Methods:** Recall study. **Results:** Very close rates of healing in HIV+ and HIV- patients. **Conclusion:** A pilot study to see that HIV + patients and HIV- patients are similar. The use of an antiviral medication does not seem to alter healing rates.

Poster #: 61

Title: Synergism and antagonism between *Aggregatibacter actinomycetemcomitans* and other oral species
Name: Jade Sha
Faculty Advisor: Casey Chen

Background: Gram-negative facultative *Aggregatibacter actinomycetemcomitans* (*Aa*) is a member of the subgingival polymicrobial community associated with periodontitis. Our recent whole genome sequence analysis of 33 *Aa* strains has divided the species into 5 phylogenetic clades. It was hypothesized that distinct strains may have different phenotypes, such as their antagonistic or synergistic relationship with other oral species. **Purpose:** To assess the synergistic or antagonistic relationship between distinct clades of *Aa* and other periodontal species. **Methods:** A 2-species mixed biofilm formation assay was performed by co-culturing each of 7 oral species with 11 *Aa* strains. The 7-oral species were: *Streptococcus gordonii* (*Sg*), *Streptococcus parasanguinis* (*Sp*), *Porphyromonas gingivalis* (*Pg*), *Dialister pneumosintes* (*Dp*), *Fusobacterium nucleatum* (*Fn*), *Eikenella corrodens* (*Ec*), and *Filifactor alocis* (*Fa*). The cultures

were incubated for 3 or 7 days under anaerobic conditions at 37°C. The amounts of biofilm were determined by a biofilm formation assay. Laser scanning confocal microscopy (LSCM) was performed to visualize bacterial composition in the co-culture between *Aa/ Dp* and *Aa/Pg*. **Results:** An antagonistic relationship was found between *Sp* and 2 *Aa* strains, between *Dp* and 1 *Aa* strain, between *Fa* and 3 *Aa* strains, and between *Ec* and 1 *Aa* strain. A synergistic relationship was found between *Pg* and 5 *Aa* strains, between *Fn* and 1 *Aa* strain, and between *Dp* and 2 *Aa* strains. *Dp* and *Pg* couldn't form monoculture biofilm but formed prosperous biofilms when co-culturing with *Aa*. **Conclusion:** Synergistic or antagonistic relationship between *Aa* and oral species is both species-specific and strain-specific.

Poster #: 62

Title: Prototype of chin distractor
Name: Waleed Soliman
Faculty Advisor: Stephen Yen

Background: Children with Treacher-Collins syndrome, Nager syndrome and Pierre Robin sequence can present with an absent chin and obstructive sleep apnea. Current treatments include silicone chin implants and genioplasty; however, chin implants can shift position and erode the underlying bone. Sliding advancement genioplasty is limited by the amount of bony contact between the mandibular body and the chin segment. This project explores an alternative approach that can produce a large chin advancement. **Purpose:** As a proof of principle, a chin distractor was developed that can advance the chin and avoid a step along the border of the mandible. **Methods:** Under IRB approval, a telescopic screw normally used for expanding the palate, was turned ninety degrees and was embedded into an occlusal splint. Two anterior arms were bent vertically so that the arms aligned with the chin. A wire loop was soldered to the ends of these arms to receive a wire from the chin. During surgery, temporary anchorage screws were added so that the splint could be anchored against the teeth and mandible. A plate taken from the RED distractor (KLS Martin, Jacksonville, FL) was adapted to fit the lower chin. The plate was attached with bone

screws, and transmucosal wires from the chin were attached to the distractor arms. Osteotomies were made in the lower chin. In order to ensure good bone contact, the osteotomy design did not allow the segment to disengage from the body. Five days after surgery, the expansion screw was lengthened 1 mm day until the maximum length of 21mm was achieved. The distractor was left in place for 3 months before surgical removal. **Results:** Serial photographs and cephalometric radiographs document an improvement in the facial profile and the lengthening of the chin in both an anteroposterior and vertical direction. The transmucosal wire did not produce a visible scar. The drawback to the technique was the three month consolidation period with splint and distractor attached to the patient. **Conclusion:** This first version of the distractor demonstrates the feasibility of a chin distractor. In the future, the distractor will be evaluated for its impact on alleviating obstructive sleep apnea.

Poster #: 63

Title: FAK and PYK2 are important regulators of osteogenic differentiation
Name: Andres Stucky
Faculty Advisor: Jiang Zhong

Background: Mesenchymal stem cells (MSCs) are pluripotent progenitor cells with the ability to differentiate into osteoblastic, chondrogenic, and adipogenic lineages. MSCs have attracted significant attention for their potential applications in stem cell biology and regenerative medicine. **Purpose:** To identify particular sets of genes that were significantly enriched in differentiated adipose of osteoblastic cells at various time points and might regulate mesenchymal stem cell differential commitment. **Methods:** We used microfluidic single cell capture and next generation sequencing of cultured mesenchymal stem cells treated with tyrosine kinase inhibitors to FAK and PYK2. **Results:** We identified a high presence of genes involved in Rac/Rho GTPase signal transduction of environmental cues. Small molecule inhibition of FAK and PYK2 can induce osteogenic differentiation of human MSCs in culture. **Conclusion:** Here we show that

FAK and PYK2 play an important role in the differentiation of MSCs and that inhibition of these molecules can have important medical implications for application of stem cell therapy to bone regrowth.



Poster #: 64

Title: Dlx5 plays a critical role during soft palate muscle development

Name: Hideki Sugii

Faculty Advisor: Yang Chai

Background: The oropharyngeal region plays an important role in our daily activities. Defects in the soft palate adversely affect speech, swallowing, breathing and hearing. Our previous study demonstrated that Dlx5 controls oronasal patterning in the anterior part of the palatal shelf. However, where Dlx5 is expressed in the posterior part of the palate and whether Dlx5 plays an important role in regulating the development of the soft palate has remained unknown. **Purpose:** To explore an optimal approach to soft palate muscle restoration, we need to expand our understanding of the molecular regulatory and cellular mechanisms of soft palate development. In this study, we examined the role of Dlx5 during soft palate muscle development. **Methods:** MicroCT scanning and histological analysis were performed to analyze the phenotypes of *Dlx5*^{-/-} and control mice. We also generated *Wnt1-Cre;ZsGreen* and *Dlx5-Cre;tdTomato* mice for expression pattern analysis. **Results:** *Dlx5*^{-/-} mice exhibited a shortened palate, ending in a posterior uvula-like structure. In the soft palate, loss of Dlx5 resulted in an absence of the levator veli palatini (LVP), palatopharyngeus (PLP), and palatoglossus muscles, but the tensor veli palatini was unaffected. Dlx5-positive cranial

neural crest (CNC) cells were adjacent to muscle progenitor cells in the LVP and PLP regions. Finally, loss of Dlx5 led to an increase in apoptosis and decrease in proliferation in the LVP and PLP regions. **Conclusion:** Dlx5 plays an important role during muscle development of the LVP and PLP likely via interactions between CNC-derived and muscle progenitor cells.

Poster #: 65

Title: p53 activation in BBDS-causing mutations of Fgfr2 perturbs cell fate

Name: Creighton Tuzon

Faculty Advisor: Amy Merrill

Background: Fibroblast growth factor receptor 2 (FGFR2) has been shown to promote both osteoprogenitor cell proliferation and differentiation during development, raising the paradoxical question of how a receptor tyrosine kinase modulates these distinct processes. We have previously shown that, in addition to its canonical signaling transduction activities at the plasma membrane, FGFR2 also regulates skeletal development from within the nucleolus where it modulates transcription of the rDNA repeats. We found that the *Fgfr2* mutations in the skeletal disorder bent bone dysplasia syndrome (BBDS) enhance the receptor's nucleolar activity and limit RUNX2-mediated inhibition of rDNA transcription. Enhanced activation of rDNA transcription by FGFR2 consequently holds osteoprogenitor cells in a proliferative state that resists differentiation. **Purpose:** (1) To address mechanistically how FGFR2 maintains the proliferative capacity during embryogenesis and on through adulthood by disease-causing mutations in the FGF receptor; and (2) To define the molecular and cellular consequences of *Fgfr2* mutations in order to provide insights into the functions of the FGFR2 in tissue development and homeostasis. **Methods:** ChIP-qPCR was utilized to determine both protein occupancy and histone modifications at rDNA repeats; polysome profiling was used to assess translational output from preosteoblasts expressing wild-type and mutant FGFR2; NOME-Seq was utilized to eval-

uate nucleosome occupancy and DNA methylation status; immunofluorescence was used to address protein colocalization within the nucleus and nucleolus; RT-qPCR was used to measure gene expression changes; and alkaline phosphatase assays were performed to measure osteoblast differentiation. **Results:** We discovered that BBDS specific mutations in *Fgfr2* augment the receptor-mediated recruitment of histone remodeling factors that epigenetically convert rDNA from poised to active, leading to higher levels of rDNA transcription. Higher levels of rDNA transcription, in turn, lead to the activation of p53 and the Rpl5/Rpl11-Mdm2 ribosomal stress response pathway. Inhibition of p53 rescues differentiation in osteoprogenitors with the *Fgfr2* mutations, suggesting that p53 activation is an essential pathogenic factor in BBDS and a potential therapeutic target for its prevention. **Conclusion:** Our study of mutations in *Fgfr2* that are associated with bent bone dysplasia syndrome reveal a mechanistic connection between FGFR2, ribosome biogenesis, and cellular stress that explains disease pathology. Our work helps to establish rDNA as developmentally regulated loci that receive input from FGF signaling to balance self-renewal with cell fate determination in progenitor cells. Furthermore, our findings define a common mechanism for how a single gain-of-function mutation in *Fgfr2* can lead to both congenital skeletal disorders and oncogenic transformation.

Poster #: 66

Title: SMAD6 methylation controls bone morphogenetic protein (BMP) signaling pathway and cell mobility

Name: Jian Wu

Faculty Advisor: Jian Xu

Background: The bone morphogenetic protein (BMP)/Smad signaling pathway plays a crucial role during bone development. BMP signaling is induced by the binding of ligands (eg. BMP4) to their receptors, which recruit and phosphorylate receptor-Smads (R-Smads, eg. SMAD1/5) that form complexes with SMAD4 for nuclear transcriptional regulation. SMAD6 is an inhibitory protein for the BMP/Smad signaling pathway. It binds to type I receptor to

block R-Smad recruitment; it also blocks Smad1/5/Smad4 complex formation in the cytosol. **Purpose:** However, it's unclear whether the inhibitory function of Smad6 can be switched "on and off" by post-translational modification. We hereby present that arginine 81 (R81) methylation of SMAD6 by protein arginine methyltransferase 1 (PRMT1) is required for SMAD6 inhibitory function and also plays an important role in cell migration and invasion. **Methods:** Smad6 overexpression stable cell line generation by pBabe-retroviral system; Smad6-KO stable cell line generation by CRISPR/Cas9; subcellular protein extraction; siRNA knockdown; Western blot; co-immunoprecipitation; GST-fusion protein purification from *E. coli*; IPA bioinformatics analysis. **Results:** We identified a methylation on arginine 81 (R81) of SMAD6 by protein arginine methyltransferase 1 (PRMT1). We also found that R81 methylation is required for BMP signaling-induced recruitment of Smad6 to phospho-Smad1/5 and is required for Smad6 to disrupt phospho-Smad1/5/Smad4 complex formation and the following targeting gene transactivation. Mechanistically, we discovered that N-terminal SMAD6 stabilizes the interaction between C-terminal SMAD6 and phospho-SMAD1/5 for exerting its full inhibitory function. Disruption of R81 methylation results in loss of inhibitory function because of an increase in binding between N-terminal and C-terminal SMAD6 which results in a "closed" conformation. **Conclusion:** In summary, R81 methylation of SMAD6 not only defines the duration and intensity of BMP-induced SMAD1/5 signaling pathway but also directly controls cell mobility.

Poster #: 67

Title: Distinct regulatory mechanisms of TGF- β receptors during craniofacial development

Name: Yuan Yuan

Faculty Advisor: Yang Chai

Background: Craniofacial malformation such as cleft lip/palate is the most common congenital birth defect in humans. TGF- β signaling is critical for skeletal development and cartilage formation as well as cardiovascular development. In

addition, mutations in TGF- β receptors lead to Loeys-Dietz and Marfan syndromes. However, loss of TGF- β type I versus type II receptors result in similar but distinct phenotypes in mice, suggesting that they mediate distinct downstream targets during palatal, frontonasal and mandible development. **Purpose:** In this study, we investigated the distinct downstream targets mediated by TGF- β type I and type II receptors that lead to different phenotypes after their loss in mice. **Methods:** To investigate the effect of TGF- β signaling on craniofacial development, we generated mice with conditional knockout of *Alk5* or *Tgfr2* in neural crest cells (*Wnt1-Cre;Alk5*^{fl/fl} and *Wnt1-Cre;Tgfr2*^{fl/fl}). **Results:** We generated *Alk5* and *Tgfr2* mutant mice and observed that both mutant mice developed similar craniofacial phenotypes including cranial bone malformation, cleft palate and short mandible. However, in certain regions, such as the frontonasal area and mandible, *Alk5* mutant mice have a more severe phenotype compared to *Tgfr2* mice. In the developing frontonasal process, we found increased cell apoptosis in the medial nasal processes of *Alk5* mutant mice at E11.5. Also, Shh ligand and *Ptch1* receptor were upregulated in the medial nasal processes of *Alk5* mutant mice, whereas no significant difference was found in *Tgfr2* mutant mice. In the developing palate of *Alk5* mutant mice, TGF- β signaling was elevated and may be activated through the TAK1-ERK1/2 pathway. **Conclusion:** In conclusion, our data suggests that *Alk5* and *Tgfr2* mediate distinct downstream signaling and targets during frontonasal and palatal development.

Poster #: 68

Title: Ameloblastin is a novel membrane-binding protein with an amphipathic helix

Name: Jingtian Su

Faculty Advisor: Janet Oldak

Background: In ameloblastin-null mice, ameloblasts are detached from the matrix and lose their polarity, leading to severe enamel hypoplasia. However, the molecular mechanism by which ameloblastin regulates amelogenesis remains unknown. **Purpose:** To study the interaction between

cell membrane and ameloblastin. **Methods:** We used leakage assay, clearance assay, DLS and TEM to investigate the membrane integrity and the size of vesicles in the presence of ameloblastin or the peptides representing different regions of ameloblastin; CD to investigate the curvature sensitivity of ameloblastin and its mutants; confocal microscopy to investigate the interaction between FITC-labelled wild type or mutant ameloblastin and cells; and sequence alignment to analyze the conservation across species. **Results:** Ameloblastin disrupted the membrane integrity, transformed larger vesicles into smaller ones, and bound to the processes of cells, which are more highly curved than cell bodies. The α -helix content of ameloblastin increased in the presence of vesicles and was more sensitive to the vesicles of higher curvature (smaller in size). Deletion of exon 5 resulted in significant loss of these functions. Peptide AB2 derived from exon 5 disrupted the membrane integrity, while peptides derived from other regions did not. The α -helix content of AB2 increased significantly in the presence of vesicles and formed an amphipathic helix. The sequence for this helix is highly conserved across mammalian species, but poorly conserved across non-mammalian tetrapod species. **Conclusion:** Ameloblastin is a novel membrane-binding protein with an amphipathic helix.



Poster #: 69

Title: Enamel matrix protein co-localization pattern within developing mouse incisor

Name: Rucha Bapat

Faculty Advisor: Janet Oldak

Background: Previous studies have shown colocalization of amelogenin- ameloblastin at the secretory face and within thickness of enamel in developing molars (Gallon et al. 2013, Mazumder et al. 2014, 2016). In-vitro studies revealed that N-terminal fragments of amelogenin, which subsequently remain until maturation stage (Mazumder et al. 2016), are involved in interaction with ameloblastin (Su et al. 2016).

Purpose: To visualize changes in amelogenin – ameloblastin co-localization pattern within developing mouse incisor at a sub-micron resolution using a High Resolution Confocal Microscopy. **Methods:** Post-natal day 5 mice were used as a model for secretory and maturation stages of amelogenesis. The mandibles were dissected; fixed in 4% paraformaldehyde and decalcified in 10% EDTA for 24hrs in the presence of fixative. Seven μ m thick sections were cut from paraffin embedded mandibles maintaining the integrity of the developing incisor. Immunolabeling was performed using: anti- full length amelogenin and anti-M300 ameloblastin primary antibodies; followed by secondary antibodies conjugated with FITC and Alexa 594 respectively. Imaging was performed using Leica SP8 confocal microscope. Colocalization patterns within the developing incisor were analyzed with Leica Application Suite (LAS) X version 1.8.1.13759. **Results:** High percentage of colocalization between amelogenin and ameloblastin was observed within secretory stage ameloblasts. Mander's colocalization coefficients were determined to be consistently high (~0.88) for amelogenin and ameloblastin. High levels of colocalization were also observed within the Tomes' processes at the secretory face of ameloblasts. However, the intensity of amelogenin signal was higher outside the ameloblasts than within the cells, whereas ameloblastin signal was greater inside the cells. Thickness of the enamel matrix was approximately doubled at the tip of the incisor (transition stage) as compared to the secretory stage. The Tomes' processes appeared narrower and sharper than secretory stage. Mander's colocalization coefficients continued to be high (~0.93) within the transition stage ameloblasts. **Conclusion:** Using sub-micron resolution confocal microscopy we report that amelogenin and ameloblastin colocalize inside the secretory ameloblasts and at the Tomes' processes. These results, together with previous in-vitro and in-vivo findings support the idea that amelogenin and ameloblastin may play a co-operative role in shaping enamel architecture.

Poster #: 70

Title: Identification of proteins interacting with wild-type or mutant PMP22 protein

Name: Yuting Cheng

Faculty Advisor: Pragna Patel

Background: Charcot-Marie-Tooth disease type 1A, an inherited peripheral neuropathy, is associated with a 1.5 Mb duplication including *PMP22* while point mutations in *PMP22* underlie CMT1E. Excessive or defective Pmp22, accumulates in cytosolic aggregates and is retained in the endoplasmic reticulum. Little is known about the aberrant interactions of over-expressed or mutant PMP22 with Schwann cell proteins. Knowledge of these interactions would be useful in identifying therapeutic drugs or assessing the mechanism of candidate small molecules. **Purpose:** We aimed to identify proteins interacting with wild-type(wt) or mutant(mut) PMP22 protein. We hypothesized that mutations in *PMP22* result in altered interactions with Schwann cell proteins that could provide insights into disease mechanism and also identify targets for therapy. **Methods:** We utilized a novel interacting protein screen that couples proximity-dependent biotinylation with proteomics using BioID2, a promiscuous bacterial biotin ligase which when fused to a bait protein can biotinylate all proteins within 10 nM of the bait. We reasoned that proteins that directly or indirectly interact with wt-PMP22 or mut-PMP22 could be identified if we expressed wt or mut-PMP22 fused to BioID2, treated the cells with biotin and examined the interactome by affinity purification and proteomics. **Results:** We created stable inducible rat Schwann cell lines expressing BioID2 fused to human PMP22 (wt or PMP22 with L16P or G150D mutations) or to RFP (control). **Conclusion:** We have conducted pilot experiments to ensure that the transgenes are expressed and optimized conditions for capture of the biotinylated proteins. We have obtained preparative quantities of the biotinylated proteins which are being subjected to mass spectrometric analysis.

Poster #: 71

Title: Neural crest-derived pericytes in development and disease

Name: Casey Griffin

Faculty Advisor: Ruchi Bajpai

Background: Forebrain pericytes are integral players in the blood-brain barrier (BBB). Defects in or loss of functional forebrain pericytes leads to breakdown of the integrity of the BBB, causing leakage of toxins and viruses into the brain and compromising the immune-privileged brain. This project will help to gain a better understanding of the uniqueness of forebrain pericytes, as well as open the door for potential therapeutic avenues or approaches to delay or stem the onset of Alzheimer's disease and other diseases involving neural crest-derived pericytes. **Purpose:** Leakiness of the BBB has recently been found to play a part in numerous neurodegenerative diseases, most notably Alzheimer's disease. Despite their importance, little is known about forebrain pericytes and what makes this population of pericytes both able to maintain the BBB and prone to damage. My project focuses on understanding what defines forebrain pericytes as a unique pericyte population, with emphasis on their developmental source as well as their transcriptome and epigenome architecture. **Methods:** I have developed a novel method for generating pericytes in vivo from cranial neural crest cells, and have characterized these pericytes via morphology, immunocytochemistry, RNA-seq, and in vitro and in vivo functional assays. Aside from characterization of forebrain pericytes, I have begun to use this method to model diseases associated with neural crest-derived pericytes, such as Alzheimer's disease and CHARGE syndrome, using patient iPSC-derived pericytes. **Results:** The method I generated is successful in producing an unlimited amount of neural crest-derived forebrain pericytes. This system can be used to compare patient cells to control cells in order to begin to understand the role forebrain pericytes play in these diseases. **Conclusion:** This project will help the pericyte field gain a better understanding of the role forebrain pericytes play in development and disease, as well as improve the methods used to characterize and identify forebrain pericytes both in vitro and in vivo.

Poster #: 72

Title: The in vivo T cell immune

responses to *Aggregatibacter actinomycetemcomitans*
Name: Susan Mahabady
Faculty Advisor: Parish Sedghizadeh

Background: The present project entailed investigation of the local and systemic immune responses to oral *A. actinomycetemcomitans* inoculation. Wild type (WT) D7S-1 and double knockout of leukotoxin and cytolethal distending toxin ($\Delta\text{ltx}\Delta\text{cdt}$) *A. actinomycetemcomitans* strains were compared in order to examine some of the virulence factors. **Purpose:** *Aggregatibacter actinomycetemcomitans* is a keystone pathogen associated with oral and non-oral biofilm infections, such as periodontitis, peri-implantitis and endocarditis. In an effort to gain insight into the immune response to *A. actinomycetemcomitans*, live organisms were inoculated into rat oral mucosa. **Methods:** *A. actinomycetemcomitans* experimental strains or sham control was injected into rat oral mucosal tissue at t=0 and t=3 days. Animals were clinically examined daily and experimental end points were set at 1 week and 3 weeks post-inoculation. Upon euthanasia, local clinical responses were evaluated, and draining lymph nodes were examined for T cell (Treg and Th17) immune responses by flow cytometry and quantitative polymerase chain reaction (qPCR). **Results:** An increase in the proportion of Th17 cells and decrease in Treg cells over the experimental period of 3 weeks were observed in response to both WT and $\Delta\text{ltx}\Delta\text{cdt}$ bacteria. Furthermore, we indicated significant up and down-regulation of proinflammatory cytokines in the Th17 gene pathway. **Conclusion:** Overall, the data presented here are consistent with previous studies on oral infection and immune responses. Further studies are required to better understand the immune responses to *A. actinomycetemcomitans* infection over time, and elucidate the involvement of virulence factors in disease pathogenesis.

Poster #: 73

Title: Amelogenin-inspired peptides for enamel mimetics
Name: Kaushik Mukherjee
Faculty Advisor: Janet Oldak

Background: The predominant enamel matrix protein amelogenin

self-assembles to control crystal orientation, elongation and packing, forming structured arrays of carbonated hydroxyapatite crystals during enamel biomineralization. **Purpose:** To rationally design amelogenin-inspired peptides with functional domains that can demonstrate organized self-assembly and control oriented growth of enamel-like crystals in situ. **Methods:** Human third molars were sectioned longitudinally into 2mm-thick tooth slices and were immersed in a demineralizing solution (pH 4.6) for 2 hours. Peptides (P26 & P32) were applied to the demineralized windows and the slices were placed in artificial saliva (pH 7) for 3-7 days. The assembly, morphology, composition and mechanical properties of newly formed crystals were characterized using AFM, TEM, SEM, XRD, Vickers microhardness and Nanoindentation tests. **Results:** The peptides demonstrated organized self-assembly on charged HAP surfaces (001) forming characteristic spherical nanostructures ~20-25nm in diameter, similar to native amelogenin. SEM revealed a dense homogeneous mineralized layer composed of needle-like de novo crystallites after 3 days, which matured to a more robust, well-oriented apatitic layer in 7 days. The regrown crystals assembled perpendicularly to the enamel surface and consolidated into a tight interface with the underlying native enamel. The microhardness values of the synthetic peptide-treated tooth samples were comparable to those achieved with the natural peptide (LRAP) and significantly higher than those of conventional fluoride-treated tooth samples. **Conclusion:** Our results demonstrate that amelogenin-inspired peptides hold a promising potential in the development of durable, biomimetic, complex apatite microstructures for enamel repair and engineering.

Poster #: 74

Title: Oral findings of cancer pre-disposition conditions
Name: Anh Pham
Faculty Advisor: Pedro Sanchez-Lara

Background: Multiple Endocrine Neoplasia (MEN) is a rare congenital disorder that involves high risk for development of medullary

carcinoma of the thyroid (MTC), pheochromocytoma, and parathyroid adenoma or hyperplasia. The patient presented with positive findings of the syndrome such as papillary nodules on her tongue, narrow face, prominent lips, and mild periorbital and conjunctival erythem. **Purpose:** To report on the case of a patient who presented to the oral surgery clinic for evaluation of her multiple distal tongue papillary nodules. **Methods:** Ultrasound of thyroid. RET gene sequencing. Plasma calcitonin level test. **Results:** Elevated calcitonin level and positive finding of RET proto-oncogene confirmed diagnosis of MEN type 2B. **Conclusion:** Typical and atypical oral presentations should be considered "Red Flags" for dental, oral and craniofacial providers to recognize for early diagnosis, referral and management.



Poster #: 75

Title: Runx2 is critical for epithelial homeostasis of mouse incisors
Name: Nelson Poliran Jr.
Faculty Advisor: Yang Chai

Background: The Runt-related transcription factor 2 (Runx2) is critical for the osteoblastic differentiation of mesenchymal stem cells (MSCs), and its expression in osteoblast cells is necessary for bone formation. In mouse embryo, Runx2 also exerts an influence in the alveolar remodeling process for tooth eruption. However, little is known about the role of Runx2 in the homeostasis of epithelial tissue. **Purpose:** Determine the role of Runx2 in the homeostasis of the mouse incisor. **Methods:** We generated *Runx2* conditional knockout mice (*Gli1-CreER;Runx2^{lox/lox}*), in which *Runx2* activity was lost in Gli1+ incisor epithelium stem cells after induction with tamoxifen at one month of age. H&E staining, immunohistochemistry and MicroCT scanning were performed to analyze the phenotypes of these

mice. **Results:** Runx2 is expressed in the stem/progenitor cell region of the cervical loop in the incisor epithelium but not the mesenchyme. In *Gli1-CreER;Runx2^{lox/lox}* mice, there is an enamel defect and *AMLX* expression is dramatically reduced, indicating ameloblast differentiation is impaired. We detected an accumulation of abnormal K14+ epithelial tissue in the mutant incisor. Moreover, the dentin is thickened but disorganized and the pulp chamber is smaller in incisors of *Gli1-CreER;Runx2^{lox/lox}* mice. The number of transit amplifying (TA) cells in both the epithelium and mesenchyme is greatly reduced in Runx2 mutant incisors. **Conclusion:** Runx2 may be a marker for incisor epithelium stem/progenitor cells. Furthermore, Runx2 is critical for ameloblast differentiation and for homeostasis of the incisor epithelium.

Poster #: 76

Title: Fgfr2 regulates formation of attachment units in the craniofacial complex
Name: Ryan Roberts
Faculty Advisor: Amy Merrill

Background: Fibroblast Growth Factor (FGF) signaling plays a critical role in skeletal development, as mutations in Fibroblast Growth Factor Receptor 2 (*FGFR2*) manifest with at least 10 distinct skeletal birth defects. Loss of function mutations in *FGFR2* causes Lacrimoauriculodentodigital (LADD) Syndrome, which is characterized by a posterior shortening of the jaw; retro-micrognathia. **Purpose:** We hypothesized that the posterior jaw shortening in LADD indicates a role for *FGFR2* in the development of the jaw processes. **Methods:** To test this hypothesis, we employed a conditional knockout mouse in which *Fgfr2* is ablated within the neural crest-derived skeletal precursors of the jaw. **Results:** We found that *Fgfr2^{lox/lox}; Wnt1-Cre* mice have jaw deficiencies at sites of joint interfaces on the condyle, angular process and ramus at the tendon/ligament-to-bone attachment units. Histological and molecular markers indicate that at these regions, endochondral-like bone has replaced the developing entheses. The entheses has been shown to differentiate into chondrocytes, tenocytes or ligamentocytes.

Lineage tracing analysis in addition to a tendon specific knockout of *Fgfr2* suggest that the change in cell fate is autonomous to the entheses progenitor cells and not caused by the ablation of *Fgfr2* in the underlying bone. **Conclusion:** Altogether, this suggests a role for Fgfr2 in cell fate determination of the entheses progenitor cells in the jaw.

Poster #: 77

Title: The PMCA and NCKX3 calcium transporters in amelogenesis
Name: Sarah Robertson
Faculty Advisor: Michael Paine

Background: While calcium transport in the maturation stage of amelogenesis has been well studied, calcium transport in the secretory stage is poorly understood. The PMCA1 (*Atp2b1*), PMCA4 (*Atp2b4*), and NCKX3 (*Slc24a3*) transporters have recently been shown to be expressed in secretory stage. **Purpose:** Our goal is to determine the role of the PMCA and NCKX3 calcium transporters in secretory stage amelogenesis calcium homeostasis and initial enamel mineralization. **Methods:** Mandibular incisors from 9-day-old wild-type and *Atp2b1^{+/-}* mice were sectioned and studied through immunofluorescence of PMCA1, PMCA4 and NCKX3, and through hematoxylin/eosin (H&E) staining. 4-week-old rat mandibular incisors were dissected and the secretory and maturation stage enamel organ isolated for Western blot analysis. **Results:** PMCA1 and PMCA4 are expressed at the lateral border of ameloblasts, while PMCA4 is also strongly expressed in the secretory stage stratum intermedium and the maturation stage papillary layer. NCKX3 localizes to the Tomes' processes and has some minor intracellular granular reaction in secretory stage ameloblasts, and localizes to the apical membrane in maturation stage ameloblasts. No noticeable change in PMCA4 or NCKX3 localization exists in the *Atp2b1^{+/-}* sections, but the *Atp2b1^{+/-}* sections exhibit abnormal attachment between the ameloblasts and forming enamel. PMCA1 and PMCA4 are more highly expressed in the secretory compared to maturation stage, while NCKX3 expression is similar between the two stages. **Conclusion:** We iden-

tified the spatiotemporal localization and protein expression of PMCA1, PMCA4, and NCKX3 throughout amelogenesis in the enamel organ. Future experiments aim to identify how mutations in *Atp2b1* and *Atp2b4* affect secretory stage calcium homeostasis and enamel mineralization.



Poster #: 78

Title: Nuclear Fibroblast Growth Factor signaling in skeletal development
Name: Joanna Salva
Faculty Advisor: Amy Merrill

Background: Fibroblast Growth Factor (FGF) signaling plays crucial roles in osteochondroprogenitor cell proliferation and differentiation as seen in the multiple skeletal dysplasias resulting from abnormal FGF signaling. Dominant *FGFR2* mutations in Bent Bone Dysplasia Syndrome (BBDS) enhance a normal, non-canonical, nuclear role for FGF signaling in osteoprogenitor cells where it promotes proliferation over differentiation. BBDS is characterized by an under-mineralized calvarium, craniosynostosis, hypoplastic clavicles, scapula and pubis as well as bent long bones. **Purpose:** The role nuclear *FGFR2* signaling plays in vivo during skeletal development remains unclear. **Methods:** Utilizing the chick embryonic system, we targeted expression of the BBDS *FGFR2* mutations in limb skeletal mesenchyme through viral induction to uncover the influence of nuclear *FGFR2* on skeletal development. **Results:** We found that expression of the BBDS *FGFR2* mutations resulted in abnormal joints, expanded epiphyses, increased proliferative cells and, most notably, bowed long bones similar to those seen in patients with BBDS. **Conclusion:** This data

suggests that nuclear *FGFR2* plays a role in regulating endochondral ossification and joint development.

Poster #: 79

Title: Nuclear reorganization driving cell fate transition in neural crest cells
Name: Kaivalya Shevade
Faculty Advisor: Ruchi Bajpai

Background: Neural crest cells are an ectodermally derived multipotent population which along with generating neuroectodermal cells such as neurons and glia also give rise to mesenchymal cells such as cartilage, bone, muscle etc. It has been demonstrated that epigenomic changes accompany cell fate switches. We do not yet completely understand the mechanisms neural crest cells employ to change their epigenomes such that they can reprogram to mesenchymal cells. Transcription factor (TF) based strategies to reprogram cells have shown that, it is possible to change cell fates by mere expression of cell type specific transcription factors. However, the efficiency of such reprogramming events is extremely low. We think that the mechanisms which neural crest cells employ to change their epigenomes, could possibly also underlie cellular reprogramming. **Results:** We can visualize for the first time nuclear reorganization, where we observe micron scale movements of DNA within the nuclei. Owing to the micron scale DNA movements the nuclei transiently expand and contract. We call this event nuclear reorganization. Nuclear reorganization correlates with acquisition of mesenchymal fate. We have identified CHD7, a chromatin remodeling protein to be necessary for nuclear reorganization and the subsequent mesenchymal transition. **Methods:** We generate human neural crest cells (NCC) in vitro from human embryonic stem cells using the protocol described in Bajpai et al.(2010). We induce mesenchymal transition in these neural crest cells by using defined media conditions. Transcriptomic characterization of the cells before and after induction is done by RNAseq. To check CHD7's role in this nuclear reorganisation we generated a shRNA CHD7 knock-

down embryonic stem cell line and CHARGE patient ips lines and differentiated them to make neural crest cells. **Conclusions:** CHD7 dependent nuclear reorganization event is essential for neural crest mesenchymal transition. We hypothesize that a change in the higher order 3D chromatin structure may underlie the nuclear expansion in this CHD7 dependent nuclear reorganization responsible for inducing a mesenchymal transition in the Neural Crest.

Poster #: 80

Title: The role of FGF2 signaling in the developing limb
Name: Taylor Stucky
Faculty Advisor: Amy Merrill

Background: Bent Bone Dysplasia Syndrome (BBDS) is a rare skeletal disorder caused by mutations in *fibroblast growth factor receptor 2 (FGFR2)* in which the long bones and skull are affected in early development. Our laboratory has shown that nuclear and membrane bound FGFR2 differentially regulate skeletal progenitor cell proliferation and differentiation at sites of growth and integration. FGFR2 binds with the ligand FGF2 which has five isoforms all made from the same transcript, four high molecular weight (HMW) intracellular isoforms and 1 low molecular weight (LMW) secreted isoform. The exact function of each isoform during bone development is not well understood. **Purpose:** The purpose of this study is to investigate the role of fibroblast growth factor 2 (FGF2) in skeletal development in the disease mechanism of BBDS. **Methods:** By utilizing a chicken embryo model, I study each of the five isoforms individually. I use targeted overexpression of high and low molecular weight FGF2 isoforms in ovo to identify differences in the influence of HMW and LMW isoforms on limb development. I also use this method to overexpress each of the four HMW isoforms individually in order to identify unique and overlapping functions of each of the HMW isoforms on limb development. **Results:** I have observed bent long bones, joint abnormalities, and mineralization defects in my FGF2 overexpression embryos as compared with controls. **Conclusion:** Through my research, I will gain a better understanding of the

FGF pathway during development and shed light on the skeletal abnormalities associated with BBDS.



Poster #: 81

Title: *PHF6* gene's function in inhibit cell differentiation
Name: Yuhan Sun
Faculty Advisor: Ruchi Bajpai

Background: Borjeson Forssman Lehmann syndrome (BFLS) is a rare X-linked disease with hypophrenia, thick calvarium, broad jaw, extremely large ears, dwarfism and obesity phenotype, which is caused by *Plant Homeodomain Finger Protein 6 (PHF6)* mutations. *PHF6* is an important gene, and is highly conserved in vertebrate animals. Our lab's recent study shows that the *Phf6* mopholino *Xenopus* embryos forms more neural crest cells (NCC) than the control ones, which indicates that in *Xenopus Phf6* is a negative regulator of NCC formation. **Purpose:** In my project, I try to understand the molecular and cellular basis of PHF6 function in neural and non-neural tissues during embryonic development. **Methods:** In the in vitro experiment, I am using human patients induced pluripotent stem cells (iPSC) to see whether BFLS patient cell line differentiates faster than control. I am also using clustered regularly interspaced short palindromic repeats (CRISPR)-Cas9 to mutate the *phf6* gene in zebrafish to develop *phf6* genetic mutant zebrafish to understand *phf6*'s function in vivo. **Results:** In the in vitro experiment, we found that BFLS patient iPSC not only show accelerated differentiation into NCC, but also further differentiate to multiple lineages such as neuron, glia, adipocyte, osteogenic cells at a faster rate than normal iPSC. Furthermore, this accelerated differentiation is not limited to NCC, it is also seen in neural precursors

cells (NPC), where BFLS iPSC differentiated into NCC and neuron whereas the controlled embryonic stem cells (ES cells) stay as NPC spheres. In the in vivo test, I found some injected mosaic fish have small brain and in contrast normal face, which is correlated with the human patients. In the second generation of the injected fish, death at gastrulation stage has been observed. **Conclusion:** PHF6 may have some function in inhibit cell differentiation. Also, PHF6 seems to have an important function during the gastrulation. However, more experiments still need to be done to confirm that.

Poster #: 82

Title: Understanding the role of FGFR2 in metopic suture development
Name: Lauren Bobzin
Faculty Advisor: Amy Merrill

Background: Dysregulation of developmental processes can lead to a myriad of craniofacial defects including craniosynostosis. Craniosynostosis can have serious medical implications ranging from physical deformity to cognitive and developmental defects which are currently only treatable through surgery. Research has revealed the family of fibroblast growth factor receptors, particularly FGFR2, to be central in the proper regulation of cranial suture development. However, more research is needed to understand the complex role of this molecule in controlling cellular differentiation and proliferation within the frontal bones and suture mesenchyme that comprise the posterior frontal suture. **Purpose:** This study will use the mouse model to test the hypothesis that *Fgfr2* is critical for regulating development of the posterior frontal suture and acts as a switch between proliferation and differentiation through asymmetric cell division. Completion of this study will contribute significantly to understanding the pathology of craniosynostosis and advance the potential for treatments for suture regeneration and repair. **Methods:** Through a combination of histological, molecular, and in vitro analyses, I aim to elucidate the role of *Fgfr2* in regulating cell fate determination, asymmetric cell division during cellular differentiation, and self-renewal of mesenchymal progenitor cells

during the development and fusion of the posterior frontal suture. **Results:** Preliminary data shows a defect in the formation of the posterior frontal suture in neural crest specific conditional knockouts of *Fgfr2* **Conclusion:** Further analysis is needed to determine the developmental origin of this defect and determine the key players affecting the establishment of metopic suture tissues.

Poster #: 83

Title: Arginine methylation of Smad6 mediates TGF- β -induced repression of NF-kB signaling
Name: Tingwei Zhang
Faculty Advisor: Jian Xu

Background: TGF- β is a potent anti-inflammatory cytokine that regulates Toll-like receptor (TLR) signaling. MyD88 degradation driven by the Smad6-Smurf pathway is a novel mechanism for TGF- β -mediated negative regulation of MyD88-dependent pro-inflammatory signaling. **Purpose:** We hypothesized that Smad6 methylation modulates TLR and TGF- β signaling crosstalk to regulate inflammatory responses. **Methods:** Cell culture; immunoprecipitation; immunostaining; ligature periodontitis model; Western Blot. **Results:** We found that PRMT1-mediated Smad6 methylation was required for Smad6 association with MyD88 and silencing PRMT1 enhanced LPS-induced NF-kB signaling. Furthermore, Smad6 methylation mediated TGF- β and BMP-induced repression of TLR4-MyD88-NF-kB activation in human skin epithelial cell and mouse primary gingival cells. Overexpression of Smad6 wildtype inhibited NF-kB activation and NF-kB-induced pro-inflammatory cytokine expression, while overexpression of methylation-deficient Smad6 did not inhibit NF-kB pathway. We further identified that Smad6 is highly expressed in periodontal gingival epithelium and Smad6 expression is dampened in periodontitis. Local deletion of *Prmt1* exacerbated the expression of pro-inflammation cytokine TNF α in gingival tissue of ligature-induced mouse periodontitis model. Consistently, deletion of *Prmt1* aggravated alveolar bone resorption caused by periodontitis. **Conclusions:** In conclusion, Smad6 arginine

methylation plays a critical role in TGF β /BMP4 induced repression of NF-kB signaling pathway. These studies establish a role for protein methylation in oral inflammatory responses.

Poster #: 84

Title: Validation of small molecules for rescuing CHARGE Syndrome-associated birth defects
Name: Krystal Mendez
Faculty Advisor: Ruchi Bajpai

Background: Our lab focuses on understanding molecular mechanisms regulating neural crest development in order to study disorders like CHARGE Syndrome, where mutations in a single copy of the gene *CHD7* affects proper development of Neural crest cells as well as neural precursor cells. The disorder manifests in utero and no cures for CHARGE syndrome exist till date. We have established a system that recapitulates the early stages in development of neural precursor cells (NPCs) and neural crest cells (NCCs) from hESC in a dish. This can be utilized to understand and develop innovative therapies for neurocristopathies. **Purpose:** To define cellular defects associated with CHARGE syndrome in a human stem cell differentiation system and to utilize it to discover novel therapies for patients affected with this neurocristopathy. **Methods:** I have characterized molecular and cellular defects in formation of NCCs and NPCs from patient derived iPSCs and normal controls. This allows for testing efficacy of small molecules in rescuing CHARGE specific defects associated with NCC and or NPCs. I will use candidates from focused small molecule screen on CHARGE syndrome model in Zebrafish that have a positive effect on rescuing CHARGE-like defects. **Results:** Our lab has established several CHARGE patient iPSC with defined mutations in *CHD7* gene. Differentiation from CHARGE iPSC results in defective neural crest and neural precursor formation, survival and maturation. These include cell-cell interaction in development of neural ectodermal spheres, poor neural crest cell migration, and defect in neural precursor formation. PA-2017 a positive candidate identified from the Zebrafish screen for CHD7 morphant rescue was

found to be effective in rescuing multiple CHARGE iPSC differentiation defects, making it a promising candidate for therapeutic use in patients with CHARGE syndrome. **Conclusion:** *CHD7* mutation can lead to defects in neural crest formation. Our recent studies demonstrate a rescue in NCC and neural precursor formation using PA-2017, that can potentially be used to treat individuals that suffer from CHARGE.

Poster #: 85

Title: Monetite-apatite phase transformation for an enamel-like dental restorative material
Name: Amrita Chakraborty
Faculty Advisor: Janet Oldak

Background: It is an important goal to develop a dental restorative material that has seamless interfacial integration, thus providing long-lasting adhesion to the tooth. We have demonstrated that our newly designed amelogenin-inspired peptides can promote regrowth of an enamel layer integrated with natural enamel and dentin. In separate experiments we have recently synthesized a layered chitosan-monetite composite that can transform into an organized hydroxyapatite composite with improved mechanical properties. **Purpose:** Our long-term goal is to develop a biomimetic CaP based restorative material, which will seamlessly integrate with the tooth structure. This study aims to investigate the effect of an amelogenin-inspired peptide on the morphology and composition of biomimetic CaP prepared from monetite-chitosan composite. **Methods:** The biomimetic CaP composite was prepared by mixing 0.2 g of the solid phase (monetite-chitosan composite, 0.15g; Ca(OH) $_2$, 0.05 g) and 100 μ l of liquid phase (Na $_2$ HPO $_4$, 1 M, pH 8.8) at room temperature. A small amelogenin-derived peptide (P32, 0.2mg/ml) containing the active domain of amelogenin was used to promote apatite crystal formation. The morphology and composition of final products were characterized by scanning electron microscopy (SEM) and X-ray diffraction (XRD). **Results:** Organized bundles of apatite crystals were formed through the monetite-apatite transformation in the presence of the amelogen-

in-inspired peptide P32. In addition, the orientation degree of these crystals was increased from 0.31 to 0.54 as a result of adding P32 during the sample preparation. **Conclusion:** The addition of amelogenin-inspired peptides promoted monetite-hydroxyapatite transformation to form oriented enamel-like crystals in the biocomposite. Future studies will investigate the mechanical properties of the developed biocomposite and its integration with dental enamel and dentin.



Poster #: 86

Title: Loading asymmetry following ACL reconstruction: laboratory and ecological testing
Name: Ming-Sheng Chan
Faculty Advisor: Susan Sigward

Background: Persistence of asymmetrical loading during sub-maximal tasks in individuals following ACLr is suggestive of habitual behavior reinforced through daily activities versus the ability to meet mechanical demands of loading. **Purpose:** To determine laboratory measures of natural loading symmetry and loading ability relate to daily loading behavior following ACL reconstruction (ACLR). **Methods:** Five individuals post-ACLR (98 \pm 16 days) and 5 controls participated. Loading symmetry during unistructured and feedback conditions was measured to assess natural loading symmetry and loading ability during sit-to-stand (SS) and squat (SQ) in laboratory. Daily loading was quantified using wearable insoles. Effect size (ES) was calculated to indicate differences in loading symmetry during laboratory daily tasks between groups. The relationships between daily loading and natural loading symmetry during squatting were determined with Pearson correlation. **Results:** ACLr group exhibited greater asymmetry during natural condition than controls (SS ES: 7.42; SQ ES: 5.3) but similar symmetry during the feedback condition (SS ES: 7.42; SQ ES: 5.3). ACLr group had reduced daily loading symmetry compared to controls (ES: 2.07). Laborato-

ry-measured natural loading symmetry during squatting was related to daily loading symmetry ($r = .78$, $p = .067$). **Conclusion:** Individuals following ACLr load asymmetrially even when they are able to meet task demands. The degree of asymmetry during squatting is related to daily loading asymmetry suggesting this pattern may be reinforced throughout the day.

Poster #: 87

Title: Systematic review of neurological biomarkers for post-stroke motor recovery prediction
Name: Bokkyu Kim
Faculty Advisor: Carolee Winstein

Background: There is growing interest to establish recovery biomarkers, especially neurological biomarkers, to develop new therapies and prediction models for the promotion of stroke rehabilitation and recovery. However, there is no consensus among the neurorehabilitation community about which biomarker(s) have the highest predictive value for motor recovery. **Purpose:** To review the evidence and determine which neurological biomarker(s) meet the high evidence quality criteria for use in predicting motor recovery. **Methods:** We searched databases for prognostic neuroimaging/ neurophysiological studies. Methodological quality of each study was assessed using a previously employed comprehensive 15-item rating system. We used the GRADE approach and ranked the overall evidence quality for each category of neurologic biomarker. **Results:** Seventy-one articles met our inclusion criteria; 5 categories of neurologic biomarkers were identified: diffusion tensor imaging (DTI), transcranial magnetic stimulation (TMS), functional MRI (fMRI), conventional structural MRI (sMRI), and a combination of these biomarkers. Most studies were conducted with individuals after ischemic stroke in the acute and/or subacute stage (~70%). Less than one-third of the studies (21/71) were assessed with satisfactory methodological quality (80% or more of total score). sMRI and the combination biomarker categories ranked "high" in overall evidence quality. **Conclusion:** There were 3 prevalent methodological limitations:

(a) lack of cross-validation, (b) lack of minimal clinically important difference (MCID) for motor outcomes, and (c) small sample size. More high-quality studies are needed to establish which neurological biomarkers are most predictive for post-stroke motor recovery. Finally, the quarter-century old methodological quality tool used here should be updated by inclusion of more contemporary methods.



Poster #: 88

Title: Resistance exercise improves skeletal muscle outcomes in prostate cancer survivors
Name: Jacqueline Kiwata
Faculty Advisor: Todd Schroeder

Background: Androgen deprivation therapy (ADT), a primary treatment for prostate cancer, is associated with adverse metabolic changes that can lead to sarcopenia, decreased strength and altered anabolic and metabolic signaling in skeletal muscle. Resistance training has been shown to increase strength in prostate cancer survivors (PCS) on ADT, but no interventions have concomitantly improved sarcopenia or examined mechanisms underlying skeletal muscle changes. **Purpose:** To determine whether a 12-week intervention of periodized resistance training (PRT) can positively alter skeletal muscle-related outcomes in PCS on ADT. **Methods:** Thirty-two PCS on ADT were randomized to PRT (n=13) or control stretching (CS; n=19). Sarcopenia index was calculated from dual-energy x-ray absorptiometry as appendicular skeletal mass (ASM)/height². Strength was assessed by 10-repetition maximum on leg press and seated row. Gene ex-

pression for IGF1, PGC-1 α and GLUT4 was analyzed from muscle biopsy samples (PRT n=9, CS n=8) using quantitative real-time PCR. Kruskal-Wallis and linear mixed models adjusted for baseline values were used to compare group differences at baseline and post-intervention. **Results:** No differences in baseline characteristics or daily protein intake were found between groups (P>0.05). Significant increases in ASM (mean \pm SE; 0.65 \pm .27 kg; P=0.01), sarcopenic index (0.23 \pm .01 kg/m²; P=0.005), leg press (114.7 \pm 16.7 kg; P<0.001), and seated row (21.53 \pm 2.8 kg; P<0.001) occurred in PRT compared to CS. PRT exhibited non-significant changes in IGF1 (-57.2 \pm 60.8; P=0.386), PGC-1 α (41.1 \pm 44.0; P=0.441) and GLUT4 (14.5 \pm 8.2; P=0.178) compared to CS. **Conclusion:** A 12-week PRT intervention increased skeletal mass and strength in PCS on ADT. Future studies are warranted to elucidate molecular mechanisms underlying skeletal muscle changes in this population.

Poster #: 89

Title: Tibiofemoral kinematics influence the location and magnitude of patella stress
Name: Tzu-Chieh Liao
Faculty Advisor: Christopher Powers

Background: It has been proposed that elevated patellofemoral joint stress is an underlying cause of patellofemoral pain (PFP). Although persons with PFP have been reported to exhibit higher joint stress compared to pain-free individuals, the location of peak stress has not been evaluated. Hypothetically, the medial patella facet is less capable of tolerating high levels of stress given that it is smaller in size and has a less cartilage volume to dissipate joint reaction forces. As such, elevated stress on the medial patella cartilage may be more detrimental to joint health. **Purpose:** To determine whether the location and magnitude of peak patella cartilage stress varies among runners with and without PFP. **Methods:** Twelve females with PFP and 10 pain-free controls participated. Peak patella cartilage stress was quantified using a subject-specific FE model. Chi-Square analysis and independent t-test were used to determine whether the location

and magnitude of peak patella cartilage stress (medial facet or lateral facet) varied between groups, respectively. **Results:** The proportion of runners who exhibited peak cartilage stress on the medial and lateral patella facets was statistically similar between groups. No group differences were found for the magnitude of peak cartilage stress on the medial or lateral facets. **Conclusion:** The location and magnitude of peak patella cartilage stress was similar among runners with and without PFP.

Poster #: 90

Title: Structuring of muscle coordination by distinct neural populations in human motor cortex
Name: Moheb Yani
Faculty Advisor: Jason Kutch

Background: It remains unknown how the human brain generates coordinated patterns of muscle activity. **Purpose:** Here we examine competing hypotheses - one in which the motor cortex “activates” coordination patterns that are subcortically encoded, and one in which the motor cortex “structures” coordination patterns by co-activating distinct neural populations that output to separate muscles with different functions. **Methods:** To disambiguate these hypotheses, we exploit properties of coordination between pelvic floor and gluteal muscles in humans. **Results:** Using electromyography (EMG), we first show that the brain can voluntarily access two main types of coordination patterns with these muscles: one pattern activates pelvic floor muscles independently of gluteal muscles (isolated-pelvic), and a second pattern activates the pelvic floor prior to but in proportion with gluteal muscles (gluteal-pelvic). Using functional magnetic resonance imaging (fMRI), we show that isolated-pelvic and gluteal-pelvic coordination patterns involve very similar motor cortical representations, suggesting the presence of intermingled neural populations with distinct muscle function that can be independently activated. Using transcranial magnetic stimulation (TMS), we show that the isolated-pelvic coordination pattern can be elicited during rest but that the gluteal-pelvic coordination pattern requires voluntary pre-activation of gluteals, suggest-

ing that the distinct neural populations are distinguished by activation threshold. TMS did not reveal any delay in excitation of gluteal activation relative to pelvic floor activation as would be predicted by the hypothesis that motor cortex simply activates subcortically-encoded muscle coordination patterns. **Conclusion:** We propose that common input to distinct neural populations with activation threshold differences provides a mechanism by which the nervous system may structure spatiotemporal muscle coordination at a motor cortical level.

Poster #: 91

Title: Mobile-based ecological momentary assessment of paretic hand use following stroke
Name: Yi-An Chen
Faculty Advisor: Carolee Winstein

Background: Limited use of the paretic hand after stroke can severely constrain an individual’s daily function. The presence of the non-use phenomenon, which describes the discrepancy between motor capability and daily hand use, underscores that fact that motor capability, while a necessary factor, may not be the only influence on paretic hand use. Recent studies demonstrate that social-cognitive factors (SCFs), which characterize an individual’s psychological perceptions, play an essential role in functioning after stroke. However, a significant knowledge gap exists in understanding the relationship of self-efficacy, affect, and social environment to paretic hand use. **Purpose:** Our goal is to investigate the impact of SCFs on paretic hand use in stroke survivors’ daily environment, by employing an innovative application of a mobile-based prompt methodology – Ecological Momentary Assessment (EMA). **Methods:** In this 5-day community study, participants received 6 EMA prompts/day. EMA prompts include questions capturing participants’ real-time responses of SCFs and paretic hand use. **Results:** On average, 30 individuals with chronic stroke responded to 84.5% of the 30 total prompts during participation. Hierarchical linear regression revealed that self-efficacy was a critical factor (p < 0.001) in paretic hand use in addition to motor capability. The

statistical model with both self-efficacy and motor scores explained an additional 6% of the variance in paretic hand use over the model with motor scores alone (p = 0.0006). **Conclusion:** Our results suggest that self-efficacy is a critical factor affecting individuals’ paretic hand use in the day-to-day environment. Self-efficacy may be an important construct to be considered when designing stroke rehabilitation regimens.



Poster #: 92

Title: Impact of enhanced self-efficacy on motor learning in Parkinson’s disease
Name: Yu-Chen Chung
Faculty Advisor: Beth Fisher

Background: Reduced balance self-efficacy has been demonstrated as an independent predictor of postural instability and gait deficits for individuals with Parkinson’s disease (PD), leading to the possibility that self-efficacy may be a potential target to improve motor performance. Boosting self-efficacy via increasing an individual’s expectations for future success has been shown to enhance motor performance and learning in non-disabled adults. However, this positive effect remains to be determined in PD. **Purpose:** This study aims to investigate the impact of enhanced self-efficacy on motor learning in individuals with PD. **Methods:** Thirty-five participants with PD practiced balancing on a stability platform. Participants were assigned to two enhanced expectancy (EE) groups or a control group. Both EE groups received an enhanced expectancy statement at early practice. One EE group (EE with definition) was given performance criteria, whereas another EE group (EE without definition) was not. The control group re-

ceived no statement and no performance criteria. Self-efficacy was assessed and a motivational questionnaire was completed following practice and retention. **Results:** Self-efficacy increased after the statement. No group difference was observed in task performance during practice. The EE without definition group appeared to outperform the control and EE with definition groups at retention. The questionnaire showed that the EE with definition group reported greater nervousness than the control and EE without definition groups. **Conclusion:** There is a trend that enhanced self-efficacy facilitates motor learning in individuals with PD when no criteria associated with good performance is given. Performance criteria resulting in high nervousness may counteract the impact of enhanced self-efficacy.

Poster #: 93

Title: Attentional focus manipulation alters variability response to increased mechanical demand
Name: Abigail Fietzer
Faculty Advisor: Kornelia Kulig

Background: Variability is inherent in movement and may help protect against injury. Studies on the effects of attentional focus manipulation demonstrate potential for altering movement variability. We previously demonstrated that altering the mechanical demands of hopping alters movement variability. **Purpose:** The purpose of this study was to examine the effects of attentional focus manipulation on the variability response when shifting from typical-rate to slow unipedal hopping. **Methods:** 23 healthy subjects hopped in place at 2.0Hz and 1.7Hz \geq 25x under no directed focus (NF), internal (IF) and external (EF) foci on each limb. UCM analysis was performed subdivide foot, shank, and thigh position variability into stabilizing (VUCM) and destabilizing (VORT) variability with respect to consistency of vertical leg length. This was performed at each 1% of stance phase, then averaged within 7 equal bins. Bin-average difference between 2.0Hz-NF and the three different focus conditions at 1.7Hz for VUCM and VORT were compared with repeated measures ANOVA (3 foci x 7 bin, α =0.05). **Results:**

Focus-related differences in the shift in VUCM (p<0.01, η_p^2 =0.24) and VORT (p=0.05, η_p^2 =0.14) were found when comparing 2.0Hz and 1.7Hz hopping. Greater increases in VUCM were seen with both EF (0.0013 \pm 0.0004, p<0.01) and IF (0.0011 \pm 0.0003, p=0.04) than NF (0.0003 \pm 0.0003). Greater increases in VORT were seen with EF (0.0006 \pm 0.0003, p=0.03) and potentially IF (0.0007 \pm 0.0003, p=0.11) than NF (0.0002 \pm 0.0002). **Conclusion:** Results suggest that attentional focus manipulation may affect the shift in variability structure despite the same alteration mechanical demands.

Poster #: 94

Title: Relationship between Inter-hemispheric Inhibition and bimanual coordination in musicians
Name: Yi-Ling Kuo
Faculty Advisor: Beth Fisher

Background: As Interhemispheric inhibition (IHI) is essential for dexterous motor control, bimanual skill developed with instrument playing may account for increased IHI in musicians. However, it is unknown whether increased IHI generalizes to performance of ordinary motor skills, and whether this is dependent on instrument type. **Purpose:** To investigate 1) the relationship between IHI and bimanual coordination in musicians and 2) instrument-specific effects on this relationship. **Methods:** 36 musicians and 22 non-musicians participated. A finger sequence task (FST) was used to test symmetrical coordination. Reaction time, movement time, total time, accuracy, and variability (standard deviation, SD) of key pressing duration were recorded. The Purdue pegboard test (PPT) was used to test asymmetrical coordination, by measuring the number of assembled objects. Ipsilateral silent period (iSP) was measured in left (L) and right (R) hemispheres using transcranial magnetic stimulation to indicate IHI. **Results:** Compared to non-musicians, musicians demonstrated significantly slower reaction time, but faster movement and total time along with greater accuracy and less variability in the FST. Increased iSP (IHI; L toward R hemisphere) was correlated with decreased variability in the FST (r = -0.39) only in musi-

cians. In pianists, better symmetrical task performance (decreased FST variability) correlated with greater iSP (r = -0.53). Conversely in string players, better asymmetrical task performance (higher number of objects assembled in the PPT) correlated with greater iSP (r = 0.54). **Conclusion:** Increased IHI may enable musicians to generalize motor skills developed with musical training to common bimanual tasks, which may be dependent on the symmetrical/asymmetrical nature of an instrument.



Poster #: 95

Title: Femur and tibia rotations influence patellar tendon stress and strain
Name: Kyungmi Park
Faculty Advisor: Christopher Powers

Background: Patellar tendinopathy is common among athletes who perform repetitive jumping/landing movements. Although altered lower extremity kinematics in the frontal and transverse planes may be a risk factor for patellar tendinopathy by increasing patellar tendon loading, a comprehensive analysis in the context of patellar tendon loading has not been performed. **Purpose:** To determine the influence of femur and tibia rotations in the frontal and transverse planes on patellar tendon stress and strain using three-dimensional (3D) subject-specific finite element (FE) modeling. **Methods:** A FE model of the knee joint was developed using subject-specific (28-year-old, female, healthy) input parameters obtained from magnetic resonance images and biomechanical data during a squatting task (45° of knee flexion). The femur and tibia were rotated along their respective axes from the natural weight-bearing position to 10° (2° increments) in the frontal and transverse planes, respectively. Quasi-static loading simulations were performed using a nonlinear FE solver in ABAQUS. **Results:** Both femur and tibia motions demonstrated a linear increase in patellar tendon stress and strain values during both frontal and transverse rotations in either direc-

tion. In general, transverse plane motions had a greater influence on patellar tendon stress and strain than frontal plane motions. In the frontal plane, tibia rotations had a greater influence on patellar tendon stress and strain compared to femur rotations. In transverse plane, femur and tibia rotations showed a similar influence on patellar tendon stress and strain. **Conclusion:** The findings of this study suggest that altered lower extremity kinematics in the frontal and transverse planes may contribute to patellar tendinopathy.

Poster #: 96

Title: Does dual cortical representation of a muscle represent functional differences?
Name: Alaa Albishi
Faculty Advisor: Beth Fisher

Background: The external oblique (EO) is dually represented in primary motor area (M1) and supplementary motor area (SMA). However, it is unknown if this dual representation has a distinct functional purpose. Given that M1 is responsible for the execution of volitional movement and SMA plays a role in postural preparation, it is possible that M1 activates EO to execute volitional movement and SMA activates EO to provide postural stabilization. If this is the case, then SMA EO representational area should be connected to postural control areas while the EO representational area in M1 is connected to sensory-motor execution areas. Therefore, our first step is using functional connectivity (FC) to determine how the EO representational areas communicate with different brain areas. **Purpose:** Identify the cortical representation of EO and map the whole-brain FC of the representational areas. **Methods:** EO in M1 and SMA was mapped using Transcranial Magnetic Stimulation in 13 healthy adults. Following mapping, the MNI coordinates of the EO activation peaks were used to explore FC utilizing resting-state functional magnetic resonance imaging among 200 subjects from the 1000 connectome project. **Results:** FC analysis demonstrated that basal ganglia (BG) and cerebellum (CB) are more connected to SMA while primary somatosensory and parietal cortex are more connected to M1. **Con-**

clusion: The greater connectivity of the EO representation in SMA to BG and CB compared to M1 may support the distinct role of the SMA EO representation in postural control; whereas EO M1 connectivity with somatosensory and parietal cortex may support its role in volitional movement execution.

Poster #: 97

Title: Patellar tendon morphology following anterior cruciate ligament reconstruction (ACLR)
Name: Sara Almansouri
Faculty Advisor: Susan Sigward

Background: Bone-patellar tendon-bone autograft ACLR involves harvesting of 1/3 of the native PAT resulting in a sizeable defect in the remaining PAT and harvested bones. Increased thickness and cross section area (CSA) in the remaining tendon are thought to represent a degenerative process as they are observed along with hypochoic lesions and calcific deposits. In the absence of objective measures of tissue structure, it is not clear if the larger CSA is an adaptation to applied forces or representative of tendon degeneration. **Purpose:** Characterizing micro- and macromorphology of partially resected patellar tendons (PAT) following ACLR will contribute to our understanding of tendon adaptation and healing. **Methods:** 11 individuals status-post ACLR (5 males) participated. Longitudinal and transverse B-mode ultrasound images of surgical (sx) and non-surgical (nsx) PAT were acquired at midtendon (medial and lateral). Thickness, CSA (macromorphology) and peak spatial frequency radius (PSFR; micromorphology) were measured from images and compared between knees. **Results:** Greater CSA ($p=0.001$) and thickness (lateral $p=0.011$) were observed in the sx knee. An observable gap in tissue was found in 5/11 transverse images. PSFR of remaining PAT was not different between knees (medial $p=0.793$, lateral $p=0.535$). Tissue formed in gap had lower PSFR (indicating inferior quality) than nsx ($p=0.041$). **Conclusion:** PAT following partial resection for ACLR adapted to applied forces by increasing CSA and thickness while preserving micromorphology. However, tissue forming within the gap is lower quality when compared to nsx PAT.



Poster #: 98

Title: An exploration of skill transfer in the DOSE study
Name: Helen Bacon
Faculty Advisor: Carolee Winstein

Background: Transfer of training is important for rehabilitation, as there is insufficient therapy time to practice every task that a person might wish to perform. Thus, we need to understand how training should be structured and which tasks should be practiced in order to maximize transfer. The recent DOSE study utilized functional task practice, and so can be used to examine the relationship between task practice and transfer to unpracticed tasks. **Purpose:** Examine the effect of task practice on transfer to outcome measure tests such as the Wolf Motor Function Test. **Methods:** Therapy logs from the DOSE clinical trial were reviewed to determine which tasks were practiced, how often they were practiced, and how well subjects were able to perform them. Outcome measure scores on the Wolf Motor Function Test (WMFT) were also reviewed, and re-scored using a novel method to quantify movement quality (WMFT-RPS). **Results:** Extracting task data from therapy logs is challenging, particularly given the personalization of tasks to each participant and the progression of task difficulty concurrent with performance improvement. However, we expect to find that the amount of practice of tasks falling into general categories such as strengthening or dexterity will predict transfer to WMFT tasks that fall into the same categories, as shown by an improvement in movement quality.

ty. **Conclusion:** This project will go some way to addressing the question of where we can expect transfer to occur from therapy, which could ultimately influence the choice of tasks to practice in limited rehabilitation time.

Poster #: 99

Title: Variability of leg movement quantity across seven days during infancy
Name: Weiyang Deng
Faculty Advisor: Beth Smith

Background: Early intervention aims to increase motor experience for infants with or at risk of developmental disabilities and promote neuromotor development. However, the minimum effective dosage of motor experience for intervention is unclear. We are using wearable sensors to measure the amount of leg movements infants produce across days and relate movement experience to skill development. **Purpose:** To determine 1) whether one day is sufficient to represent an infant's typical performance, or more days are needed and 2) whether there is a difference between weekday and weekend. **Methods:** We used wearable movement sensors to collect 7 consecutive days of full-day leg movement activity, 8-13 hours per day, from 4 infants with typical development between the ages of 1-5 months. We identified each leg movement produced. **Results:** Across infants, the range of leg movements per hour of awake time across 5 weekdays ranged from: infant 1: 2527-2705, infant 2: 1794-2595, infant 3: 2075-5646, infant 4: 1615-2799. Weekend days were: infant 1: 1703-2146, infant 2: 2390-2556, infant 3: 2633-2733, infant 4: 1436-2274. When comparing to each infant's mean value across all days, individual days ranged from: 69.6%-189.3% of the mean. **Conclusion:** The variability of leg movement kinematic data across seven days is visually within the normal range in infants with typical development, around 2000-7000 movements per hour, based on previous researches. Our results will inform the clinical measure of full-day infant leg movement for neuromotor assessment and outcome measurement purposes.

Poster #: 100

Title: Effects of an older adult golf

program on postural control
Name: Andrea Du Bois
Faculty Advisor: George Salem

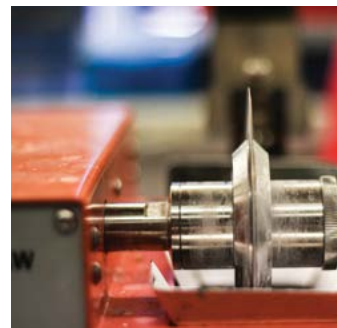
Background: Aging is associated with physiological changes including impaired mediolateral (ML) postural control that increase fall risk. Multimodal exercise can improve balance and reduce fall risk. Golf is a multimodal activity that includes walking, bending over, and golf swings. **Purpose:** The purpose of this study was to investigate the effect of a golf training program on ML postural control in older adults. **Methods:** Two, male older adults completed a twelve week (twice weekly, 90 minutes per session) comprehensive golf training program. Before and after the golf program, participants completed the rapid step test. Temporal measures of performance included weight shift time (WT) and step time (ST). ML center of pressure (COP) dynamics during the weight shift and step including ML COP range (RANGE), ML COP velocity (VEL) for the weight shift, and mean ML COP displacement (DISP) during the step were also assessed. **Results:** Following the golf training program, performance on the rapid step test improved including a shorter WT and ST. Participants increased RANGE and VEL during the weight shift and decreased DISP during the step. **Conclusion:** Following the golf program, participants were able to perform a larger and more rapid weight shift that accelerated the center of mass over the base of support in preparation for the step. During the step, participants were better able to control the momentum generated during the weight shift to allow for the safe placement of the stepping limb. Thus, it appears golf is a plausible activity intervention to improve balance in older adults.

Poster #: 101

Title: Musculoskeletal screen to identify orthopedic impairments in youth baseball players
Name: Erica Harris
Faculty Advisor: Jonathan Sum

Background: Current literature discusses regional screening procedures but lacks a feasible com-

prehensive process. **Purpose:** To develop a standardized screen of physical tests and measures associated with injury risk and performance enhancement related to youth baseball players. **Methods:** This is a retrospective 3-year review of 46 male youth baseball players who were screened as part of a community outreach program to identify potential risks for injury. This screen tests the upper and lower extremity examining physiologic measurements. The athletes were given individualized programs with the focus of injury risk reduction and performance enhancement. **Results:** Average Strength of Throwing Arm (TA): Shoulder External Rotation (ER) 10.9kg, Shoulder Internal Rotation (IR) 13.2kg Average Strength of Non-throwing arm (NTA): Shoulder ER 10.3kg, Shoulder IR 12.0kg Average Passive Range of Motion (PROM) TA: Shoulder ER 89.7 degrees, Shoulder IR 38.4 degrees Average PROM NTA: Shoulder ER 85.8 degrees, Shoulder IR 40.0 degrees Average Total Arc Shoulder PROM: TA 127.6 degrees, NTA 133.4 degrees Average Shoulder Horizontal Adduction: TA -4 degrees, NTA 6.2 degrees Average Hip IR ROM of Leading Leg: 29.2 degrees, Trailing Leg: 27.0 degrees Average Thoracic Spine Rotation: Throwing Side 7.4 degrees, Non-Throwing Side 7.6 degrees **Conclusion:** This comprehensive musculoskeletal screen measures orthopedic impairments and can be performed onsite with minimal equipment and time by physical therapists, athletic trainers and physicians. The information from this screen can direct further attention and treatment with individualized programs to prevent injury for sport performance enhancement in high school male baseball players.



Poster #: 102

Title: Is the ability to learn encod-

ed in the resting brain?

Name: Andrew Hooyman
Faculty Advisor: Carolee Winstein

Background: There are reports of individuals who are unable to learn a novel motor skill even after extensive practice (Brooks et al. 1995). Our long-term goal is to discover a simple, accurate and reliable brain biomarker of motor learning capability; this would promote development of personalized training programs to foster motor learning in athletic and rehabilitation settings. **Purpose:** Our primary aim in this study is to determine if resting-state electroencephalography (rs-EEG) can be used to classify motor learning capability in non-disabled individuals. **Methods:** Fifteen non-disabled adults (8 females, mean age 26.6 +/- 2.7 yrs) participated. We used a discovery learning task to discriminate discovers and non-discovers of the rule (i.e., movement strategy) that governed task success. We adapted the Brooks' (1995) task--the objective is to use a thumb joystick to move a cursor from a start box to a stop box in < 3 sec. Based on performance over 200 practice trials, participants were classified as discovers ($n=12$) or non-discovers ($n=5$). Prior to practice, 5 min of rs-EEG was acquired using a 64 lead EEG cap. We used a decision tree analysis to predict classification group. **Results:** 30% were classified as non-discovers. The prefrontal cortex--temporal lobe rs-EEG connectivity most strongly predicted behavioral classification. Cross validation achieved an 80% overall classification accuracy, 81% sensitivity and 75% specificity. Given the high accuracy and sensitivity, we plan to replicate these findings in a larger sample of healthy adults, and extend this line of inquiry to a disabled population of chronic stroke survivors. **Conclusion:** Given the high accuracy and sensitivity, we plan to replicate these findings in a larger sample of healthy adults, and extend this line of inquiry to a disabled population of chronic stroke survivors.

Poster #: 103

Title: Obstacle negotiation strategies with leg visual feedback in immersive VR
Name: Aram Kim
Faculty Advisor: James Finley

Background: The ability to successfully navigate obstacles in environments requires integration of visual information about the environment with estimates of our body's state. Previous studies have investigated how information about the body and impending obstacles are integrated to mediate a successful clearance strategy using partial occlusion of the visual field. However, because these manipulations often remove information about both the body and obstacle, it remains unclear how leg information alone is utilized during obstacle crossing. **Purpose:** Therefore, we used an immersive virtual reality interface to test a hypothesis that individuals' performance of a virtual obstacle negotiation task would be best with a volumetric leg model because this model provides the most information about one's body state. **Methods:** 12 participants wore a head-mounted display while walking on treadmill and were instructed to step over obstacles in a virtual corridor in four different feedback trials: (1) No model of the legs, (2) an endpoint-only model, (3) a link-segment model, and (4) a volumetric-segment model. **Results:** We found that participants with the volumetric model achieved higher success rate compared to no model. Moreover, participants with both volumetric-segment and link-segment models placed their trailing foot before crossing and leading foot after crossing more consistently, and placed their leading foot closer to the obstacle after crossing compared to no model. **Conclusion:** Our findings suggest that a full leg model, regardless of volume information, can improve performance and produce more consistent behavior. This knowledge may provide information about the fidelity necessary to reproduce obstacle negotiation tasks in immersive VR.

Poster #: 104

Title: Infants explore to learn and coordination changes
Name: Jeongah Kim
Faculty Advisor: Linda Fetter

Background: Infants born VPT (<32 weeks gestational age) are at high risk for impairments in motor coordination. To encourage infants to generate more mature,

out-of-phase hip-knee coordination, our lab reinforced vertical leg movements of 3 to 4-month infants born FT and VPT using an overhead infant mobile. Some infants born FT and VPT learned that their leg movements activated the mobile, but only the infants born FT demonstrated more out-of-phase hip-knee coordination (e.g. hip flexes while knee extends). We modified the mobile paradigm to motivate specifically more out-of-phase hip-knee coordination for infants born VPT. **Purpose:** (1) To determine if infants born full-term (FT) and very preterm (VPT) can learn a modified mobile paradigm; (2) To determine if infants change their hip-knee coordination under four different mobile conditions **Methods:** Four, 4-month old infants born FT participated in a modified mobile paradigm on two consecutive days. Each infant was placed supine under a mobile. Day 1 consisted of a 2-min baseline condition (spontaneous kicking) followed by an 8-min mobile condition (musical mobile rotates when the infant lifts his foot vertically a certain height). Day 2 consisted of an 8-min mobile condition. **Results:** Two infants learned the task and demonstrated more out-of-phase hip-knee coordination when activating the mobile compared to spontaneous kicking. Two infants did not learn or change their hip-knee coordination. **Conclusion:** The modified mobile paradigm is feasible for infants born FT and affected changes in hip-knee coordination. Our next step is to complete data collection of infants born FT and VPT.

Poster #: 105

Title: Effect of Exercise on remnant cholesterol in breast cancer survivors
Name: Kyuwan Lee
Faculty Advisor: Christina Die-li-Conwright

Background: RC is a subset of triglyceride-rich lipoprotein that serves as a novel biomarker for increased cardiovascular disease (CVD) risk. The combination of aerobic and resistance exercise has been recommended to reduce risk of CVD in BCS, yet it is unclear as to whether combined exercise decreases RC. **Purpose:** This study sought to examine the effects of a 16-week aerobic and resistance exercise intervention

on remnant cholesterol (RC) in breast cancer survivors (BCS). **Methods:** Thirty sedentary BCS (Stage I-III) who completed cancer treatment within 6 months prior to enrollment were randomized to the Control group (CON) or the Exercise group (EX). The EX group underwent supervised, progressive moderate-vigorous aerobic and resistance exercise sessions thrice weekly for 16 weeks. The CON group was asked to maintain their current level of activity. RC was calculated as total cholesterol-HDL-LDL. Paired t-tests and two-way repeated measures ANOVA were used to examine the effects of exercise training on RC. **Results:** At baseline, EX (n=15) and CON (n=15) groups did not differ by total cholesterol (196.4 ± 37.5 mg/dL), LDL-C (101.9 ± 31.2 mg/dL), HDL-C (42.7 ± 5.7 mg/dL), and RC (51.7 ± 28.8 mg/dL). Following the 16-week exercise intervention, RC levels were significantly reduced (45.2 ± 13.8 to 9.9 ± 2.5 mg/dL; $-31 \pm 0.5\%$) in the EX group when compared to baseline ($P < 0.01$) and to the CON group ($P = 0.01$). **Conclusion:** A 16-week aerobic and resistance exercise program improves biomarkers related to CVD risk and should be considered as a non-pharmacologic strategy to reduce the risk for CVD mortality in BCS.

Poster #: 106

Title: Encountering a slip with arms constrained increases likelihood of falling
Name: Jonathan Lee
Faculty Advisor: Christopher Powers

Background: Injuries resulting from falls rank as the 5th highest healthcare cost in the United States and that number is projected to increase. Previous literature has focused on the response movements of the lower extremities and as a consequence, little attention is devoted to the upper extremities. This study may provide evidence that the arms are important for regaining balance. **Purpose:** The purpose of this study is to investigate the importance of the arms in regaining balance from a slip perturbation. By constraining the arms, we may compare two groups (arms constrained and arms free) and observe fall rate between the two groups. **Methods:** Nineteen

adults (Age: 23.8 ± 2.13 years old) were recruited for this study. Participants were screened for health concerns and deemed healthy for participating. Participants were separated into two groups: an arms free condition where they walk naturally, or a second group that has their arms bound by cuff restraints. All individuals were instructed to traverse across a 10m walkway at a constant gait speed of 1.4 m/s while attached to a low-friction trolley system via a full-body harness. Oil was placed on a teflon tile that was camouflaged in the walkway when the participants were unaware and a slip was induced. Falls were visually determined by inspection of the lower extremity movements. **Results:** Participants with their arms bound experienced a fall rate of 50% compared to a fall rate of 33% for individuals with their arms free. **Conclusion:** Individuals that encounter a slip without the ability to use their arms increase their risk of falling by 66%. Future studies could investigate the effects of carrying objects (grocery bags, computers, etc.) when encountering slips to evaluate the risk of falling when performing daily activities.

Poster #: 107

Title: Inter-joint compensations during early gait in individuals following ACL reconstruction
Name: Paige Lin
Faculty Advisor: Susan Sigward

Background: Biomechanical studies report reductions in knee flexion range of motion during loading response (LR) at 3 months post-anterior cruciate ligament reconstruction (ACLR) when gait appears normal. The presence of altered knee kinematics in the absence of observable gait deficits suggests individuals are compensating to normalize gait. **Purpose:** To compare inter-joint coordination during gait between individuals 3 months post-ACLR and controls. **Methods:** Thirteen individuals ($9F, 23 \pm 7.0$ yrs) 91 ± 18 days post-ACLR without observable gait deficits and thirteen controls ($4F, 24 \pm 5.7$ yrs) walked at 1.4m/s ($\pm 5\%$). 3D kinematics (250 Hz) and anthropometrics were used to quantify sagittal plane ankle, knee and hip angles (inverse dynamics). Hip-knee and knee-ankle coupling angles were calculated

(vector coding) in the reconstructed (ACLR), non-surgical (NS), and averaged control (CTRL) limbs during LR (0-25% of stance). Coupling angles were categorized into coordination patterns: in-phase, anti-phase, knee phase, and ankle/hip phase. Frequency of coordination patterns between limbs was compared using Kruskal Wallis tests; post-hoc: Mann-Whitney U; $\alpha \leq 0.05$. **Results:** During LR, frequency of knee phase motion was reduced in the ACLR limb compared to NS and CTRL limbs for hip-knee (35% vs. 50% and 51%, respectively) and knee-ankle (17% vs. 21% and 26%) couplings. Anti-phase hip-knee coordination was greater in the ACLR limb (40% vs. 29% and 23%). **Conclusion:** Decreased knee phase motion in both couplings is consistent with limited knee motion previously reported. Differences in inter-joint coordination indicate intralimb hip and ankle compensations in the ACLR limb that occur at a time when gait is normalized clinically. Intralimb compensations may aid in restoring the appearance of unimpaired gait.



Poster #: 108

Title: Sex differences in hip kinematics and muscle activation during running
Name: Jia Liu
Faculty Advisor: Christopher Powers

Background: Excessive hip adduction during weight bearing has been linked to various lower extremity injuries (eg. patellofemoral pain). Compared to males, females exhibit excessive hip adduction during both late swing phase and stance phase of running. Pilot data from our laboratory has revealed that hip adduction at initial contact is predictive of peak stance phase hip adduction. Greater activity of the hamstrings relative to the gluteus maximus during late swing phase could bias the hip towards adduction,

as gluteus maximus functions as a hip abductor (upper fibers) and the hamstring group adducts the hip. **Purpose:** To evaluate sex differences in: 1) frontal plane hip kinematics, and 2) relative recruitment of gluteus maximus to hamstrings during the late swing phase of running. **Methods:** 18 female and 17 male runners (18-45 yrs) participated. Surface electromyography of the upper gluteus maximus, and medial and lateral hamstrings, along with 3D kinematic data, were obtained as participants ran at a speed of 3.4 m/s along a 14-m runway. **Results:** When compared to males, females exhibited a significant greater hip adduction (12.8 ± 0.6 vs 9.7 ± 1.4 , $p = 0.032$), and a significant lower gluteus maximus/hamstring activation ratio (0.3 ± 0.0 vs 0.6 ± 0.1 , $p = 0.022$) during the late swing phase of running. **Conclusion:** A lower gluteus maximus/hamstring activation ratio may contribute to the greater hip adduction during late swing phase of running in female runners. This is important as the hip adduction angle at initial contact is predictive of peak hip adduction during stance.

Poster #: 109

Title: Can golf influence gait speed and cognition in older veterans?
Name: Nicole Marcione
Faculty Advisor: George Salem

Background: Gait speed is an important predictor of successful aging. For example, slow gait speeds are associated with poor health outcomes and decreased dual-task (DT) walking performance is associated with increased fall risk. **Purpose:** The purpose of the present study was to examine the influence of a 12-week golf intervention on walking performance and cognition in older military veterans. **Methods:** Gait speed and cognition were measured before and after a 12-week golf intervention (2 x weekly; 90 min per session). Two male participants (74 and 67 years) completed 5 gait trials walking as fast as possible, 5 dual-task gait trials walking as fast as possible while performing a digit subtraction task, and neuropsychological assessments (executive function and memory) which make up the Fluid Cognition composite score of the NIH Cognition Toolbox. **Results:**

Participants improved gait speed by 5.3% and 15.8% and fast DT gait speed by 29.2% and 26.1%. Fluid Cognition composite scores improved by 11% and 1%. **Conclusion:** Following the 12-week golf intervention, both participants improved their fast gait speed, fast DT gait speed, and fluid cognition function. There was little to no decrease in counting accuracy during the fast DT gait speed. These results demonstrate that the participant's improved gait speeds were not at the expense of maintaining cognitive performance. These preliminary findings suggest that the physical and cognitive demands of golf may improve physical and cognitive function in older veterans, leading to their improved quality of life.

Poster #: 110

Title: Full spectrum of involuntary force variability emerged from neuromechanical interactions
Name: Akira Nagamori
Faculty Advisor: Francisco Valero-Cuevas

Background: Involuntary force variability is inherent to human motor control and may contain useful information for clinical and scientific purposes. However, the sources of frequency-specific force variability and their interactions in health and disease are not well understood. **Purpose:** The objective of this study is to understand interactions between muscle-tendon units and proprioceptive feedback in the generation and modulation of involuntary force variability. **Methods:** We used a physiologically-grounded closed-loop simulation of afferented muscle to investigate the interactions among different sources of force variability. This closed-loop simulation included a realistic muscle-tendon model, muscle spindle, Golgi tendon organ, and a tracking controller to perform isometric force tracking tasks well characterized in the literature. **Results:** We demonstrate that closed-loop tracking with an afferented muscle-tendon unit suffices to replicate and explain surprisingly many cardinal features of involuntary force variability. Specifically, we present 1) a potential origin of low-frequency (< 5 Hz) force variability, 2) an in-depth characterization

of how proprioceptive feedback generates/modifies 5-12 Hz physiological tremor, and 3) evidence that altered strength of proprioceptive feedback influence the entire spectrum of force variability in well-recognized frequency ranges. **Conclusion:** These results highlight the previously underestimated importance of closed-loop neuromechanical interactions in explaining involuntary force variability during voluntary 'isometric' force control. Furthermore, we propose a unifying theory that relates spinal circuitry to various manifestations of altered involuntary force variability in healthy aging and neurological disease.

Poster #: 111

Title: Characterizing dynamic balance during adaptive locomotor learning
Name: Sungwoo Park
Faculty Advisor: James Finley

Background: When people step on a rough terrain or icy surface and walk, they initially adjust their steps to make themselves more stable and ultimately adapt their walking pattern to the environment. In recent years, adaptation to walking on a split-belt treadmill has been used as a common paradigm to explore how humans and other vertebrates adapt to walking in an asymmetric environment. When people walk on a split-belt treadmill, they initially walk with an asymmetry characterized by steps of unequal length, then gradually adopt a symmetric walking pattern characterized by steps of the same length. Although it's been proposed that the adoption of a symmetric walking pattern may result from a desired to maintain dynamic balance, this has yet to be investigated. **Purpose:** Determine how healthy individuals control kinematics of the center of mass relative to the base of support during split-belt adaptation. Over the course of split-belt adaptation, we hypothesized that the margins of stability on the fast belt will be greater than on the slow belt. Additionally, people will initially have an asymmetric time to contact and converge to symmetric behavior during adaptation. **Methods:** We used a computational model and experiment to explore how dynamic balance is influenced by spatiotemporal asymmetry during walking on a split-belt treadmill.

The model was constructed based on a two-state exponential model which calculates foot placement at each step from the measured step length and time asymmetry. In the experiment, participants adapted to walking on a split-belt treadmill with the left belt moving at 1.5 m/s and the right belt moving at 0.5 m/s. Retroreflective markers were used to measure lower extremity kinematics and compute spatiotemporal metrics such as step length, dynamic margins of stability, and time-to-contact. **Results:** We found that people showed greater margins of stability on the fast belt than on the slow belt during adaptation by adjusting their foot placements relative to the body's center of mass. The results also showed greater times to contact on the slow belt than on the fast belt during adaptation and the difference between the fast and slow belt decayed during adaptation. These experimental results were consistent with the simulation using the model. **Conclusion:** People showed greater margins of stability on the fast belt and reductions in time to contact asymmetry during adaptation. These behaviors resulted from adjustment of foot placement as we predicted from the computational model. Our results will help to improve our understanding of the role of biomechanics in driving adaptive changes to coordination when walking in novel environments.

Poster #: 112

Title: Development and feasibility of a positioning device survey
Name: Marcelo Rosales
Faculty Advisor: Beth Smith

Background: It has been suggested that excessive use of positioning devices (e.g strollers, car seats, and bumbo seats) can constrain an infant's movements and negatively affect rate of motor development. Quantitative literature exists regarding the constraining nature of these devices in the short term, but minimal literature exists concerning how frequent these devices are used across days and months. **Purpose:** The purpose of this study was to develop and assess the feasibility of a smartphone based survey that inquires parents about their uses of positioning devices with their infants. **Methods:** Two researchers, who

have backgrounds in infant and child development, developed the survey questions and the smart phone based application using PACO (The Personal Analytics Companion). After development of the survey, caregivers were instructed on how to download and access the survey on their smartphone. Caregivers were inquired on two randomly selected days of the week, for two weeks. Each day of surveying included six surveys separated by two-hour gaps (24 total surveys). Feasibility will be assessed using the participants' response rate to the survey and feedback. **Results:** Currently, 4 caregivers with infants ranging 1 week to 12 months have been recruited for our study. Preliminary results show that a single participant's response rate was 33% to the survey. **Conclusion:** These data may indicate that the current method is not feasible, but further results are needed to conclude this assumption. If not feasible, we will look into alternative surveying schedules (e.g participant selected days) and assess the rational for a possible low response rate.

Poster #: 113

Title: Cognitive contributions to posture in persons with low back pain
Name: K Michael Rowley
Faculty Advisor: Kornelia Kulig

Background: Non-specific LBP is an incredibly large problem with up to 80% of adults experiencing an episode at least once and many suffering from recurrent symptoms. Motor control changes during symptom remission have been identified in these patients. While many researchers have investigated psychometrics or movement impairments, little work has been done investigating interactions between these measures. **Purpose:** The purpose of this study was to investigate the effects of dual-task interference on trunk control during a dynamic unstable postural task in participants with and without recurrent low back pain (LBP). **Methods:** Six pain-free controls and four participants with recurrent LBP were recruited to participate in the study per IRB guidelines. Participants completed three trials of a balance-dexterity task, then three trials with a concurrent cognitive dual-task. Participants also com-

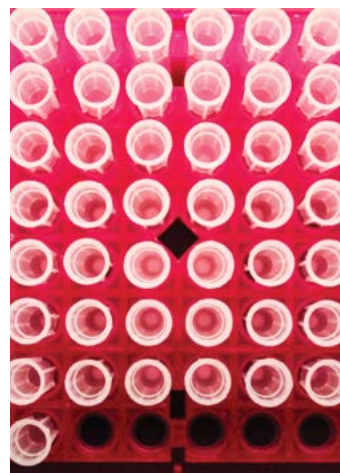
pleted the Movement-Specific Reinvestment Scale (MSRS), quantifying the amount of conscious attention devoted to movement. **Results:** The change in trunk coupling from single- to dual-task conditions for controls trended toward negative association with MSRS ($R = -0.70$, $p = 0.12$). EMG of paraspinals indicated pain-free participants who scored high on the MSRS also increased the ratio of multifidus-to-erector-spinae muscle activation ($R = 0.87$, $p = 0.33$). Participants with recurrent LBP showed a similar association ($R = -0.89$, $p = 0.11$) but shifted upward such that they increased trunk coupling with the dual-task. **Conclusion:** These findings indicate, despite variability in control participants, persons with recurrent LBP in symptom remission all increased trunk coupling when the cognitive task was added. These findings indicate dual-tasking should be prescribed with caution as it may increase trunk coupling in this group.

Poster #: 114

Title: Corticospinal motor excitability is associated with lower extremity stiffness
Name: Yo Shih
Faculty Advisor: Christopher Powers

Background: The purpose was to explore the extent to which lower extremity stiffness during landing can be explained by corticospinal motor excitability (CME) of vastus lateralis (VL) and gluteus maximus (GM). **Purpose:** A high-risk movement strategy related to knee injury has been characterized by higher than normal lower extremity stiffness which leads to higher than normal knee valgus angles and moments during landing. Previous studies have reported that muscle strength only explains 20% of the variance in this landing strategy which suggests that altered motor control may play a role. **Methods:** Five healthy participants were recruited for this pilot study. Hip and knee joint torsional stiffness (JTS) was quantified by the change of the joint moment divided by the change of the joint excursion during deceleration phase of a drop-jump task. Transcranial magnetic stimulation (TMS) was used to measure the CME of the VL and GM. Participants were dichotomized

into high and low stiffness groups based on their hip and knee JTS. Student's t-test was performed to compare group differences in CME of VL and GM which was quantified as the maximal slope of the input-out curve (IOC) obtained from the TMS assessment. **Results:** Participants who exhibit higher knee and hip JTS exhibited greater slopes of the IOC of VL and GM respectively, compared to persons who exhibited lower knee and hip JTS. **Conclusion:** Our preliminary findings suggest that a landing strategy characterized by high knee and hip JTS may be associated with the strength of the descending neural drive along the corticospinal motor projections.



Poster #: 115

Title: Overuse mechanisms in a dancer with flexor hallucis longus tendinopathy
Name: Hai-Jung (Steffi) Shih
Faculty Advisor: Kornelia Kulig

Background: Flexor hallucis longus (FHL) tendinopathy is highly prevalent in female ballet dancers given the extreme range of motion and overuse of the toes in their typical training. The saut de chat is a common dance leap that places biomechanical demands on the toes during push off, which may contribute to the overuse of FHL. Conceivably, even slight variation in push off may predispose or prevent dancers from developing FHL tendinopathy. **Purpose:** This study aims to compare kinematics and kinetics of saut de chat leap takeoff in one dancer with FHL tendinopathy to 30 healthy dancers. **Methods:** A dancer with FHL tendinopathy, pain-free at testing, performed saut de chat leaps taking off of her involved limb. Using a motion capture system

and inverse dynamics, range of motion and net joint moments of the hip, knee, ankle, and metatarsal phalangeal (MTP) joints were calculated. Data from the participant were time-normalized to 100% takeoff and superimposed on data from 30 healthy dancers. **Results:** The participant with FHL tendinopathy had prolonged weight acceptance compared to healthy dancers as evident by the delayed peaks in vertical GRF, which appears to be controlled by an increased MTP flexor moment during this phase. MTP joint angle was shifted 10 degrees towards extension, caused by not fully lowering the heel to the ground. **Conclusion:** Our findings demonstrate phase-specific excessive loading of the MTP joint during saut de chat takeoff in a dancer with FHL tendinopathy, potentially caused by inadequate lowering of the heel.

Poster #: 116

Title: Hourly analysis of infant leg movement durations across a day
Name: Ivan Trujillo-Priego
Faculty Advisor: Beth Smith

Background: Although efforts have been made to show the importance of variability of movement as measure of stability in relation to development of skills in infants, one of the limitations has been the inability to quantify variability across long periods of recording and capture the vast repertoire of infant movement. **Purpose:** Our goal is to measure variability in infant leg movement characteristics across days and test whether increased variability indicates instability and precedes the emergence of a new behavior. **Methods:** Inertial Measurement Units (IMUs) recorded full day leg movement. IMUs signal was analyzed to quantify the number of discrete leg movements performed and the duration of each movement. A histogram of the duration of movements was created for each hour of recording. We used a Kolmogorov Smirnov test to determine whether the distributions were normal. We calculated skewness to describe each distribution. **Results:** Normality test revealed that distributions of all hours of data were non-normal (p -value < 0.001). Our results for skewness showed that the distributions of duration of movement

remained right-skewed at every hour with skewness values ranging from 0.56 - 2.85 with an average of 1.67. Majority of movements produced each hour tended to have durations between 100 and 200 ms. **Conclusion:** The results support that infant leg movement durations were similar across hours, and may indicate stable behavior. Future work will focus on quantifying variability of duration and other kinematic characteristics of infant leg movement in relation to specific activities and the emergence of new behaviors.

Poster #: 117

Title: Arm-use patterns in chronic stroke survivors: observations from covert bimanual task-performance.
Name: Rini Varghese
Faculty Advisor: Carolee Winstein

Background: Arm use patterns in chronic stroke survivors is modulated by a number of factors including side of stroke lesion, pre-existing brain-behavior asymmetries, and prior experience. Despite growing evidence pertaining to arm use after stroke, little is known about how stroke survivors solve ecologically relevant bimanual tasks (e.g. placing letter in envelope). **Purpose:** Our primary aim is to identify volitional arm use patterns adopted for asymmetric bimanual tasks and compare these patterns between left-(LHP) and right-hemiparetic (RHP) individuals across several levels of motor impairment. **Methods:** We conducted a retrospective classification analysis of video data from two bimanual tasks (i.e. letter/envelope, photo/album) performed as part of the Actual-Amount of Use Test. Use patterns of 47 pre-morbidly right-handed stroke survivors were classified, first by pattern of use (i.e. unimanual or bimanual), and second by the role in which the paretic arm was engaged (i.e. stabilization or manipulation). Group differences in the probability of bimanual engagement were analyzed using logistic regression. **Results:** There was a significant difference between LHP and RHP groups averaged across motor impairment (Upper-Extremity-Fugl-Meyer: 19-66). Probability of bimanual-engagement was higher for the RHP compared to the LHP group, and this difference was greater

for those with moderate-to-severe impairment. Further, of those who chose a bimanual solution, a greater proportion of the RHP group used their paretic hand for manipulation, compared to that of the LHP group, which engaged it for stabilization. **Conclusion:** After stroke, we observed arm use patterns for bimanual tasks that depended on the hemisphere affected and the degree of motor impairment. Future research will systematically explore the mechanism(s) underlying these observations

OCCUPATIONAL SCIENCE & OCCUPATIONAL THERAPY

Poster #: 118

Title: Potential movement biomarkers for autism in children and adolescents
Name: Christiana Butera
Faculty Advisor: Lisa Aziz-Zadeh

Background: While social communication deficits are the hallmark of autism spectrum disorders (ASD), motor deficits are known to be common in this population as well. Recently, members of our research team showed that kinematic markers collected by playing a tablet game may be a promising biomarker for identification of ASD as compared to a typically developing population (TD) in children ages 3-6 years old (Anzulewicz et al, 2016). To our knowledge, no one has replicated this finding in an older population. **Purpose:** To replicate and extend previous findings of kinematic differences in children with ASD to an older population of children (9-14 years old). **Methods:** Four TD children and 5 children with ASD (aged 9-12) played an iPad drawing game (Anzulewicz et al, 2016) that measured gesture kinematics and gesture force using inertial sensors and touch screen touch displacements. 212 features were calculated from the inertial sensor and touch screen data (ibid). A Kolmogorov-Smirnov (K-S) test was run to identify motor features distinct between ASD and TD children. **Results:** K-S test identified seven significantly different features (JerkMagnitudeMax, JerkMin_y, JerkRange_y, AttitudeRange_y, RotationRMS_x, RotationStd-

Dev_x, JerkZeroCrossing_x) between ASD and TD groups that represented differences in acceleration of finger movements and the displacement of the iPad during movements. **Conclusion:** Results demonstrated inertial movement sensor parameter differences are key identifiers between 8-12 year old ASD and TD children, common to children 3-6 years old. Contact forces and the distribution of forces during coloring may serve as important identifiers of ASD irrespective of age during childhood, while other parameters may be age-dependent.

Poster #: 119

Title: Occupational therapy for service members with chronic symptoms following mTBI
Name: Alison Cogan
Faculty Advisor: Florence Clark

Background: Service members (SM) who develop chronic impairment related to mTBI are often referred for multidisciplinary rehabilitation, including occupational therapy (OT). However, OT intervention and scope varies widely among clinics. An overarching model to support more consistent, evidence-based approaches is needed. **Purpose:** To develop a treatment model for OT intervention to optimize participation in daily life of military SM with mTBI and persistent symptoms. **Methods:** Qualitative study consisting of two series of focus groups – one with SM who had received OT services for mTBI symptoms and another with OT professionals. Meetings were audio recorded and transcribed. Data were coded using NVivo software (QSR International, Inc.) using a priori codes for OT intervention components. Thematic coding of data that was not part of treatment model. **Results:** 6 OT professionals and 6 SM with mTBI participated in the study. All service members were enlisted Marines. Many needs prioritized by SM were addressed in current OT practice, including community reintegration and symptom management. Sleep disruption and chronic pain are important areas for SM but currently not well addressed by OT in this setting. Thematic analysis highlighted additional considerations, such as inclusion of family members in the intervention process,

differences between SM injured in combat vs. non-combat settings, and the importance of finding purpose in life at the conclusion of patients' military career. **Conclusions:** OT services, as part of a multidisciplinary intervention program, should address all domains of OT practice in assessment and treatment. In cases where scope overlaps with other disciplines, providers should coordinate to develop complementary approaches. **Conclusion:** OT services, as part of a multidisciplinary intervention program, should address all domains of OT practice in assessment and treatment. In cases where scope overlaps with other disciplines, providers should coordinate to develop complementary approaches.

Poster #: 120

Title: Strategies for improving dental encounters for children with ASD
Name: Dominique Como
Faculty Advisor: Sharon Cermak

Background: Oral health is important to physical and psychological health. Children with autism spectrum disorders (cASD) experience significant oral care challenges; however, little research on efficacious interventions to improve care for this population exists. **Purpose:** To gather information on current strategies used to facilitate successful oral care encounters for cASD. **Methods:** Focus groups of parents of cASD (5-18 years; $n = 2$) and dentists treating cASD ($n = 2$) were conducted to elicit details about the strategies employed to address oral care-related challenges. Thematic analysis following a grounded theory approach was employed. **Results:** Three themes emerged from parent stories: (1) What Makes a Good Dentist focused on dentist knowledge and experience; (2) Tricks, Tactics, and Diversions described different techniques dentists used to help improve dental visits; and (3) Preparation, Preparation, Preparation which explored strategies parents/caregivers could implement to increase the chance of a successful dental encounter. Four themes emerged from dentists' accounts: (1) Parents Know Best described how dentists valued parental expertise; (2) Desensitization explored preparing the

child for visits by encouraging practicing oral routines at home and in the office; (3) Network of Colleagues referred to dentists seeking out the advice of other healthcare professionals regarding working with cASD; and (4) Flexibility which focused on dentists altering their traditional treatment methods to accommodate the individualized needs of cASD. **Conclusion:** Findings provide insight into techniques perceived by parents and dentists that support successful dental encounters for cASD. This information has the potential to improve care for this population by identifying future areas for intervention.

Poster #: 121

Title: Assumptions of health care professionals caring for children with autism
Name: Lucia Florindez
Faculty Advisor: Sharon Cermak

Background: Some patient populations experience marginalization in health care settings. Notably, children with autism spectrum disorders (cASD) may encounter challenges when receiving medical care, and experience the stigma of being diagnosed with a disability. **Purpose:** To explore subtle hidden assumptions that may be held by health professionals regarding their coworkers and their patients with ASD and their families, and how those beliefs impact their language and actions. **Methods:** Two focus groups of dentists treating cASD were conducted to describe oral care-related challenges experienced by cASD and identify strategies to address them. Thematic analysis using a grounded theory approach was used to describe strategies to improve care. Additional codes developed inductively emerged related to the possible hidden biases of when discussing care of children with ASD and their families. **Results:** Three types of themes related to hidden assumptions were identified: (1) Microaggressions related to instances when dentists described their colleagues or patients in a manner that communicated subtle negative opinions; (2) Marginalization denoted the use of exclusionary language, such as “those kids,” which created a sense of otherness and identified cASD as different from neuro-

typical patients; and (3) Preconceptions which focused on assumptions about patients’ cultural backgrounds, and comments about the quality of education completed by their colleagues. **Conclusion:** Findings provide insight into the implicit biases that may be held by some health care professionals and how they manifest in language choices and interactions with patients and coworkers. These findings may not be unique to dental professionals, but may be present in health care providers. Further research is necessary to understand how these assumptions relate to quality of care.



Poster #: 122

Title: Complex narratives among individuals with spinal cord injuries from gunshots
Name: Carol Haywood
Faculty Advisor: Mary Lawlor

Background: Acts of violence, primarily gunshot wounds, are the third leading cause of with spinal cord injuries (SCIs) in the US. However, little work has been done to understand whether mechanisms of SCI affect rehabilitation experiences. **Purpose:** To carefully evaluate experiences and perspectives of adolescents and young adults (AYAs) SCIs from gunshot wounds in order to understand possible relationships among cause of injury and experiences in daily life. **Methods:** Individual and group interviews were used to elicit narratives from life experiences for AYAs with a SCI (n=9) and their caregivers (n=8). This analysis focuses specifically on a subset of these data from participants who were injured by gunshot (n=5) and their caregivers (n=4). Data were analyzed categorically, thematically, and narratively within- and across-cases. **Results:** For AYAs

with SCIs from gunshots, rehabilitation was a type of moral endeavor, complicated by functional abilities and social influences. For some, SCIs were understood to be a chance to start fresh, re-create one’s identity, and live a safer or more meaningful life. In other cases, SCIs perpetuated chaos within individual and family experiences. **Conclusion:** Circumstances leading to SCIs by gunshots had remarkable effects on individual experiences and goals. While further research is warranted, findings indicate rehabilitative care should account for contextual factors, including mechanisms of injury, communities of residence, and availability of support.

Poster #: 123

Title: Quantifying therapists’ activities in sensory integration intervention
Name: Cristin Holland
Faculty Advisor: Barbara Thompson

Background: Current reports from the Center for Disease Control (2014) indicate that one in 68 children are affected by autism spectrum disorder (ASD). While recent research supports efficacy of sensory integration therapy (SIT) in children with ASD, there has not been research on the quantification of behaviors exhibited by therapists and relation to changes in the child. **Purpose:** This study aims to quantify behaviors of the therapist during SIT through an innovative method in occupational science research that allows for the detailed analysis of behavioral processes. **Methods:** Ten videotapes of six occupational therapists providing SIT services to seven unique children with ASD between 18 and 60 months, (m=6, f=1) were retrospectively analyzed. A coding system of 134 behaviors in 6 distinct categories relevant to SIT was created. Using this scheme, research personnel coded the videotaped sessions with Observer XT 11 (Noldus Information Technology, Wageningen, The Netherlands). General impression scores were assigned at the end of coding each tape. **Results:** Total behaviors coded throughout sessions ranged from 388 to 1033. Verbal communications were the highest occurring therapist behaviors during SIT sessions. For general impressions

of the session and therapist, pure high intensity play and sensory experiences had the highest general impression mean score. **Conclusion:** Behavior coding in a continuous sampling manner through the Observer provides quantification of therapists’ action during SIT sessions. The most common behaviors demonstrated from therapists across SIT intervention sessions are verbal communications. The engagement between the therapist and child is an important aspect of SIT intervention.

Poster #: 124

Title: Functional interhemispheric connectivity is decreased after stroke during action observation.
Name: Kaori Ito
Faculty Advisor: Sook-Lei Liew

Background: Action observation, in which patients observe others perform actions, is a stroke rehabilitation technique thought to enhance brain activity for motor recovery. Prior neuroimaging work showed increased activity during action observation in localized regions of the AON, a cortical network comprised of motor-related areas, in individuals following stroke. However, since distinct cortical areas are known to interact with one another, we compare functional connectivity patterns in the AON between 12 left-hemisphere stroke, 12 right-hemisphere stroke, and 12 non-disabled individuals. **Purpose:** We examined whether functional connectivity patterns in the action observation network (AON) differ between stroke and non-stroke groups. **Methods:** Participants observed goal-directed hand actions during fMRI scans. SPM’s CONN toolbox was used to calculate temporal correlations of brain activity between (inter-) and within (intra-) hemisphere-specific AON regions. Connectivity values were averaged and a one-way between-subjects ANOVA was performed to examine differences between groups. **Results:** A significant effect of group on interhemispheric connectivity was found during action observation ($F(2,33)=4.8$, $p=0.01$). Tukey’s HSD test showed that the nondisabled group ($M=0.7$, $SD=0.2$) had greater mean interhemispheric connectivity values ($p=0.02$; $p=0.07$) than both

the left- ($M=0.4$, $SD=0.2$) and right-hemisphere stroke ($M=0.5$, $SD=0.2$) groups. The two stroke groups did not differ in interhemispheric connectivity values. No significant differences were found between any groups in intrahemispheric connectivity. **Conclusion:** Previous literature has shown that greater inter-, but not intra-, hemispheric connectivity within motor regions is indicative of better motor performance following stroke. In conjunction with our findings, this suggests that increasing interhemispheric connectivity during action observation may promote recovery.



Poster #: 125

Title: Transfer of skilled motor learning between virtual and conventional environments
Name: Allie Schmiesing
Faculty Advisor: Sook-Lei Liew

Background: Virtual reality provides a unique opportunity to examine how motor learning is impacted by context. In particular, HMD-VR provides an immersive experience that can potentially be harnessed to improve motor rehabilitation outcomes in clinical practice. However, how learning in HMD-VR transfers to a conventional training (CT) environment, and vice-versa, is unclear. **Purpose:** We examine the extent to which motor training in immersive head-mounted virtual reality (HMD-VR) transfers to the real world, and vice versa. **Methods:** Twenty-four, healthy, right-handed individuals were randomized into two groups (HMD-VR, CT), and practiced a skilled motor learning task in either the HMD-VR or CT environment. They then tested on the motor skill in both HMD-VR and CT environments.

Data was analyzed in MATLAB. **Results:** There were no significant differences in skill measure between groups at baseline (Block 1: $p=0.98$) or at the end of training (Block 4: $p=0.64$). In the CT group, there was a significant increase in motor skill from the last CT training block to the HMD-VR test block ($p=0.0038$), and in the HMD-VR group there was a significant decrease in motor skill from the last HMD-VR training block to the CT test block ($p=0.015$). **Conclusion:** Motor learning occurs similarly in both CT and HMD-VR. However training of a skilled motor task in HMD-VR does not fully transfer to a CT environment. Future research should explore whether this negative effect can be mitigated, and how HMD-VR can be used to affect motor rehabilitation.

Poster #: 126

Title: Linking research to practice in hand therapy: a mapping review
Name: Sandy Takata
Faculty Advisor: Shawn Roll

Background: As a type of scoping review, a mapping review provides an overarching representation of available literature within a field. When conducted in a systematic way, mapping reviews are an effective method to communicate the breadth of knowledge on a particular topic and identify gaps in the overall evidence that can guide priorities for research. **Purpose:** The purpose of this mapping review was to identify all literature regarding the treatment of distal upper extremity musculoskeletal disorders published in the last 10 years and compare this research to the American Society of Hand Therapists’ scope of practice. **Methods:** A systematic search and screening was conducted to identify evidence published from 2006-2015. Descriptive data from 191 studies were extracted and the diagnoses, interventions, and outcomes used in the literature were compared to the hand therapy scope of practice. **Results:** Osteoarthritis, tendon surgeries, and carpal tunnel syndrome were the most frequently studied diagnoses. Exercise, education, and orthotic interventions were the most common, each used in more than 100 studies; only 12 studies used activity-based interven-

tions. Primary outcome measures included range of motion, pain/symptoms, strength, and functional status. **Conclusion:** Abundant high-quality research exists for a portion of the hand therapy scope of practice; however, there is a paucity of evidence for numerous diagnoses and interventions. More evidence is needed for complex diagnoses and activity-based interventions, as well as for behavioral and quality-of-care outcomes.

Poster #: 127

Title: Barriers and facilitators to primary care for individuals with ASD
Name: Christine Tran
Faculty Advisor: Leah Duker

Background: Individuals with autism spectrum disorder (iASD) report dissatisfaction with primary care (PC), while providers report a desire for additional training to work with iASD. Limited research exists examining the challenges and potential solutions for these challenges. **Purpose:** To explore environmental barriers and facilitators impacting PC for iASD across the lifespan. **Methods:** Eleven databases were searched using the terms: Autism, medical/primary care, and environment. Data from articles were organized into environmental factor categories defined by the International Classification of Functioning, Disability, and Health (WHO, 2009). **Results:** Seventeen articles reported on PC for iASD (adults n=7 and children n=10). The first category, Products and Technology, highlighted tools to aid in determining appropriate accommodations to address communication barriers between iASD and providers. The next category, Natural Environment, emphasized sensory-based challenges and adaptations to decrease discomfort for iASD. Support and Relationships focused on barriers to iASD accessing adequate support from providers and the advantages of specialized PC clinics. The Attitudes category discussed the impact of provider misconceptions about iASD. Health Services, Systems and Policies detailed the financial disincentives providers face for accommodating iASD in PC practice. Lastly, Education Services, Systems and Policies highlighted limited provider knowledge and training regarding iASD and edu-

cational programs to address this. **Conclusion:** A variety of environmental barriers to PC are documented for iASD; however, there is limited literature on solutions for attitudinal and policy-related barriers. This review has implications for PC environment design, health care policy, and resource/training needs for providers. Further research investigating environmentally-based interventions for iASD within PC is warranted.

Poster #: 128

Title: Labeling autism: making sense of professional and autistic community discourse
Name: David Turnbull
Faculty Advisor: Mary Lawlor

Background: Autism Spectrum Disorder a neurodevelopmental disorder that is defined in the DSM-V as persistent social communication and social interaction deficits and “restricted, repetitive patterns of behavior, interests, or activities” (American Psychiatric Association, 2013). The severity of the autism diagnosis, according to the DSM-V, should be based on these two categories of deficit. The severity of autism is often labeled using the terms “high-functioning” and “low-functioning.” These terms are frequently used in research and popular media, to categorize individuals with autism but they have no official definition. Most often, these terms are defined based on IQ, with “high-functioning” autism referring to individuals with an ASD diagnosis and an IQ of 70 or above. Instead of categorizing autism based on the symptoms of the diagnosis, it is most often categorized with these functioning labels that are not based on a benchmark of ASD. **Methods:** A literature review was conducted of occupational therapy’s professional literature (academic journals and trade publications) in the United States for the past 10 years to determine the frequency of use of functioning language. A search was conducted of blogs and public community forums for the opinion of autism advocates and self-advocates. **Results:** There is a saying in the world of autism, most often attributed to Stephen Shore, “If you’ve met one individual with autism, you’ve met one individual with autism.” This

phrase has become nearly cliché in the world of autism advocates and self-advocates arguing against the labeling of people with ASD. They point out the truth that the classic image of autism that many people are familiar with does not represent the breadth of experience of individuals on the spectrum. Should that notion then be turned back against the advocates in objection to their speaking for other autistic women, men, and children who they have not met? Can one simultaneously espouse the heterogeneity of a group and claim that their opinion is representative? Can the profession of occupational therapy claim an identity that includes valuing client desires while continuing to label a group of clients against their wishes? **Conclusion:** Ethnographic research with occupational therapists working with the autistic population, in the vein of Mattingly & Fleming, would illuminate how these professionals create and sustain identity in relation to the needs and desires of their clients.

Poster #: 129

Title: Occupational therapy practitioners' perspectives on occupation-based activities in post-acute care
Name: Carin Wong
Faculty Advisor: Natalie Leland

Background: Healthcare reform is emphasizing the delivery of patient-centered evidence-based care as a means of improving patient outcomes. Thus, it is imperative for occupational therapy (OT) practitioners to demonstrate their contribution towards enhancing patient outcomes, specifically utilizing their expertise in occupational engagement. **Purpose:** To identify barriers and strategies to delivering occupation-based activities in post-acute care (PAC) from the perspectives of OT practitioners to promote patient-centered care. **Methods:** Six focus groups were conducted with OT practitioners (n=18) to identify their perspectives of understanding hip fracture patients' occupations and delivering an occupation-based approach for rehabilitation. Procedures for analyzing the data were rooted in grounded theory. Field notes, team meeting notes, and an audit trail for coding decisions were used throughout the analysis process to ensure consistency and consen-

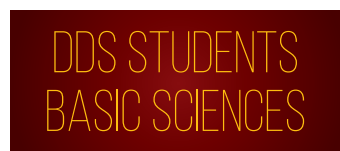
sus. **Results:** Three major themes arose from practitioners' perspectives regarding the role of occupation in rehabilitation: (1) conducting an occupational profile, (2) integrating occupation-based activity in facility, and (3) identifying goals for occupational engagement after discharge. In all three themes, participants identified barriers (i.e., patients with multiple comorbidities, lack of facility resources, and lack of family engagement) and strategies to overcome the barriers (i.e., involving families in treatment sessions, utilizing different community-based resources). **Conclusion:** This study illustrates the barriers and the strategies that are utilized to provide occupation-based activities during OT treatment sessions. Future research should evaluate other stakeholders' (e.g., patients) perspectives of occupation-based activities in PAC as well as examine the extent to which such interventions contribute to achieving desired patient outcomes.

Poster #: 130

Title: Enhancing client engagement through text messaging
Name: Kristine Carandang
Faculty Advisor: Beth Pyatak

Background: The use of text messaging in rehabilitation is categorized under telehealth, an emerging niche in occupational therapy involving the delivery of healthcare services through telecommunication and virtual technologies. Interventions that incorporate text messages have shown positive improvements in health promotion and are recommended as an approach to help facilitate the development of healthy habits. Despite this research, occupational therapists continue to report low use of telehealth in real-world clinical practice, and lack of skill to use such technology. **Purpose:** This poster will share our experiences of using text messaging as a strategy to engage young adults with diabetes in an occupation-based, lifestyle intervention. **Methods:** A text messaging component was added to the Resilient, Empowered, Active Living with Diabetes (REAL) intervention, which consisted of 10-16 hours of face-to-face sessions delivered by an occupational therapist over a 6-month period. The intervention was delivered as part of

a randomized trial targeting young adults from low socioeconomic and ethnic/racial minority backgrounds. Therapists sent each client personalized text messages with the goal of promoting habit formation and maintenance of progress toward client-centered goals. **Results:** Our data includes quantitative findings on which types of texts were successful in eliciting client responses, qualitative feedback related to receiving and responding to text messages as part of a healthcare intervention, and logistical challenges associated with using mobile technology. **Conclusion:** This poster will help inform future practice by providing occupational therapy practitioners with an understanding of how text messaging can be utilized to promote positive outcomes during therapy.



Poster #: 131

Title: AMOR in the repair for extraction socket with dehiscence defect
Name: Taewan Kim
Faculty Advisor: Seiko Min

Background: Tissue engineering approaches to bone repair involved with scaffolds, stem cells and exogenous growth factors. An alternative was proposed involving anti-Bone Morphogenetic Protein (BMP)-2 monoclonal antibodies (mAbs) immobilized on a scaffold which captures endogenous BMP to mediate bone formation. This strategy is termed antibody mediated osseous regeneration (AMOR). **Purpose:** The aim of this study sought to evaluate the ability of AMOR with the extraction socket devices called SocketKAP and SocketKAGE utilized for graft protection as well as space maintenance for bone regeneration. **Methods:** The buccal plate of extraction socket was removed up to apex of tooth to create an extraction socket with buccal dehiscence defect in canine model. All experimental sites were randomly assigned to following four groups: G1: absorbable collagen sponge (ACS) + AMOR; G2: ACS + Iso; G3: Anorganic Bovine Bone Mineral (ABBM); G4: unassisted healing. The experimental animals

were euthanized at 3 month for histologic and histomorphometric analysis. **Results:** Histologic and histomorphometric observation revealed that AMOR group maintained the contour of the alveolar crest while the knife edge appearance was seen in other groups. AMOR group demonstrated statistically greater amount of new vital bone compare to unassisted wound healing group. Iso and unassisted wound healing groups demonstrated statistically higher number of osteocyte and bone multicellular unit (BMU) than other groups. **Conclusion:** Our present data revealed the efficacy of the application of AMOR for the repair of extraction socket with dehiscence defect in canine model.

Poster #: 132

Title: TGF-B signaling regulates gingival epithelial wound healing and barrier function
Name: Lam Vuong
Faculty Advisor: Jian Xu

Background: The transforming growth factor beta (TGFB) signaling pathway is involved in the regulation of cellular growth and differentiation and has multiple roles during craniofacial developments. We found that during ligature induced periodontitis, TGF-B signaling is activated in the oral cavity but is impaired at the injury site, as determined by the absence of phosphor-Smad3 staining, an indicator of TGF-B activity, at the immediate wound site. **Purpose:** We aim to assess whether TGF-B signaling regulates gingival epithelial wound healing and epithelial barrier function. **Methods:** Mouse model of ligature-insertion induced periodontitis, immunostaining, human gingival epithelial cell (HGEC) culture, and western blot. For the wound closure assay, a scratch was generated on a confluent cell monolayer. The speed of wound closure as an indicator of cell migration was quantified by taking snapshot pictures with a microscope at time intervals following the scratch. **Results:** We found that treatment with TGF-B increases wound healing compared to that of the control, while the use of a TGF-B inhibitor (SB431542) decreases the wound healing response of HGECs, suggesting the requirement of endogenous TGF-B generated by HGEC.

Moreover, TGF-B signaling regulates epithelial barrier function. One of the key components of the epithelial barrier are tight junctions, which seal the intercellular space from exterior environment. We found that tight junction proteins zonular occludens 1 (ZO1) and Claudin 1 are increased in TGF-B treated cells and decreased in SB431542-treated cells, compared to untreated group. **Conclusion:** Our data show that TGF-B signaling promotes epithelial integrity and would healing in human gingival epithelial cells, and suggest that dampened TGF-b signaling at periodontal injury sites may be responsible for impaired epithelial barrier function. Our future studies aim to determine whether restoring TGF-b signaling promotes epithelial integrity and would healing in vivo.

Poster #: 133

Title: Flavonoids for CMV-Induced salivary gland tumor therapy
Name: Courtne Yun
Faculty Advisor: Tina Jaskoll

Background: Mucoepidermoid carcinoma (MEC) is the most common malignant tumor in major and minor salivary glands (SGs). Our laboratory has recently confirmed a causal relationship between human cytomegalovirus (hCMV) and SG MEC. Since current anti-CMV drugs are limited due to toxicity and the emergence of drug resistance, there is an urgent need for new anti-CMV treatments. **Purpose:** To determine the effect of baicalein, an "anti-viral/anti-cell signaling" flavonoid extensively used in Chinese herbal medicine, on CMV-host interactions and viral efficacy. **Methods:** Newborn ex vivo 3D submandibular gland (SGs) were cultured in the presence/absence of mouse CMV (mCMV) on day 0 for 24 hours and then in virus-free media for 10-14 days. Baicalein or the anti-viral acyclovir, either singly or in combination, was added daily on days 6-14. SG phenotypes, viral distribution, viral-induced changes key genes and proteins were analyzed using H&E histology, qRT-PCR, and immunolocalization. **Results:** Baicalein treatment of virus-infected SGs induced a marked decrease in pathology, cell proliferation and viral infection, a substantial increase in cell death in

virally-infected cells; and significant changes in gene expression. Although acyclovir treatment significantly reduces viral expression, apoptosis is not seen in tumor cells. Combination treatment was similar to those seen with baicalein alone. **Conclusion:** Baicalein is an effective anti-CMV treatment due to the targeting the CMV-infected cells and gene pathways. What remains to be discovered is the molecular mechanism of flavonoid inhibition of viral infection and tissue pathology.



Poster #: 134

Title: Deformity patterns in cleft-palate mouse by using comprehensive 3D microCT
Name: Ihnbae Cho
Faculty Advisor: Jian Xu

Background: We sometimes come across patients who have cleft palate. We noticed the cells and tissues that consist of these cleft palates derived from neural crestal tubes cells. Many proteins of these cells are regulated through post-translational modification (PTM) after its transcription and translation. During these post-translational modification amino acid, arginine motif of these proteins are methylated via methyltransferases-1 (PRMT-1) as mono-methylarginine, asymmetric di-methylarginine and symmetric di-methylarginine. **Purpose:** We hypothesized that protein arginine methyltransferases-1 (PRMT-1) catalyzes arginine to asymmetric di-methylarginine throughout the craniofacial bone development for how PRMT-1 modulates cranial facial bone development. **Methods:** To know more details of these defects we compared the length, width and volume of cranial neu-

ral cells derived craniofacial bones (frontal bone, premaxilla, maxilla, palatine bone and mandible) from E18.5 control-1, control-2, PRMT-1, and PRMT-2 mice by analyzing three dimensional (3D) micro-computed tomography (microCT) images. **Results:** When we deleted neurocrestal specific PRMT-1 gene from the mouse, we could overall observe a smaller head and dramatic defects in maxilla and palatine bone and moderate defects in premaxilla, frontal bone and mandible bone. We found that different craniofacial bones were restored to different degrees in PRMT-1 and PRMT-2 mice. **Conclusion:** PRMT-1 modulates cranial facial bone development by observing that palate shelves were failed to be elevated and fused to each other at the level of palatine bone.

Poster #: 135

Title: The role of Runx2 in craniofacial development
Name: Christie Tu
Faculty Advisor: Yang Chai

Background: Runt-related transcription factor 2 (Runx2) controls the differentiation of osteoprogenitor cells into osteoblasts, and is essential for intramembranous bone formation in early skeletal development. In humans, Runx2 haploinsufficiency results in Cleidocranial Dysplasia (CCD), which affects bone and tooth development and may or may not include cleft palate. The incidence of CCD is one per million and affects males and females equally. However, the role of Runx2 in craniofacial development is not well understood. **Purpose:** To study the role of Runx2 in craniofacial development, we generated transgenic mice with ablation of *Runx2* in the cranial neural crest-derived cells (*Wnt1-Cre; Runx2^{fl/fl}*) or the palate (*Osr2KiCre; Runx2^{fl/fl}*) and littermate controls to analyze the effects of loss of *Runx2* on the calvaria and the palatal bones. **Methods:** Histological tissue sectioning and staining followed by 3D-microCT were performed on *Wnt1-Cre; Runx2^{fl/fl}* and *Osr2KiCre; Runx2^{fl/fl}* mice as well as normal littermate controls. We also used 3D-microCT to quantify size differences in individual bones between control and *Osr2KiCre; Runx2^{fl/fl}* mutant mice.

Results: Our data showed that *Wnt1-Cre; Runx2^{fl/fl}* and *Osr2KiCre; Runx2^{fl/fl}* newborn mice lacked ossified neural crest-derived bone, and exhibited smaller heads and shortened mandibles than controls. The mutant mice models also displayed reduced tongues and cleft palate of varying degrees. **Conclusion:** These results suggest loss of Runx2 may lead to fewer mature osteoblasts. Further studies are needed to understand the mechanism and downstream target genes of Runx2 in craniofacial development. More research is needed to determine the penetrance of cleft palate in both mouse models, and to determine at which embryonic stage the palate and tongue defects first manifest.

Poster #: 136

Title: MicroCT analysis of CNC-derived bones in mice with *Alk5* knockout
Name: Donghyuck Yang
Faculty Advisor: Yang Chai

Background: Growth factors are molecules capable of stimulating cellular growth, proliferation, healing, and differentiation. TGFβ signaling is responsible for cranial neural crest (CNC)-derived bone formation. It has been shown that CNC-derived bone development is disrupted by loss of *Alk5* in CNC cells. **Purpose:** To investigate the role of *Alk5* in the development of cranial neural crest (CNC)-derived bones through microCT imaging of mice with inactivation of *Alk5* in the CNC. **Methods:** The size and volume of CNC-derived craniofacial bones (frontal bone, premaxilla, maxilla, palatine bone, and mandible) from E18.5 control and *Wnt1-Cre; Alk5^{fl/fl}* mice were compared. Analysis of 3D microCT images revealed malformation of CNC-derived bones in mice with conditional inactivation of *Alk5* in the CNC-derived lineage. **Results:** Mice with loss of *Alk5* exhibited craniofacial deformities in terms of size, volume, and surface area. This malformation of craniofacial structures was visualized with 3D microCT analysis. **Conclusion:** This study provides anatomical landmarks and numerical data of parameters for each CNC-derived craniofacial bone (frontal bone, premaxilla, maxilla, palatine bone, and mandible). This study also provides important information for develop-

mental biologists who are interested in craniofacial morphogenesis.

DDS STUDENTS CLINICAL SCIENCES

Poster #: 137

Title: Emergency management of traumatic dental injuries among school nurses

Name: Armin Afshar

Faculty Advisor: Julie Jenks

Background: Dental trauma is one of the important problems to be addressed in schools. Falls, fights, and sport injuries are some of the common causes of dental trauma in schools. **Purpose:** The purpose of this study is to determine school nurses' and school health clerks' educational experiences, opinions and professional behavior related to the management of traumatic dental injuries (TDI), specifically tooth avulsion, in school children before and after an educational intervention to increase TDI knowledge among school nurses and health clerks. **Methods:** A twenty-three question survey instrument will be administered to elementary and middle school nurses and health clerks separately during their monthly meeting to determine whether there is a need for training in the management of traumatic dental injuries. The questionnaire contains objective questions regarding the frequency of traumatic dental injuries and specifically avulsions. Participants are questioned regarding their history of education of TDI. In addition, the survey also contains questions regarding nurses' knowledge level and management skills in treating dental avulsion. There are also questions designed to obtain demographic data from the health clerks and school nurse population in Pasadena and South Pasadena, California. Each survey will be presented to an elementary or middle school nurse employed by the Pasadena Unified School District and will be collected the same day at one of their monthly meetings. The survey contains no questions leading to any identifiable data on an individual level. **Results:** The result of the surveys will be interpreted after the completion of the study in mid-March. The results

from nurses collected in February 2017 suggests the school nurses are not familiar with handling dental trauma with children at school. **Conclusion:** First part of the study suggests there is a need for CE courses for school nurses to familiarize and train them to handle dental trauma properly.

Poster #: 138

Title: The potential in development of dental technology in USC students

Name: Armin Afshar

Faculty Advisor: Santosh Sundaresan

Background: This study is a project of "Innovations for Dentistry" a student organization at USC. Dental students at USC have diverse professional and educational backgrounds and they carry a potential to use their skills in order to develop new dental technology. To achieve this, it is required for dental students to work with students in other disciplines such as engineering in a multidisciplinary setting. **Purpose:** The purpose of this study is to gauge the interest level and the potential within the students to engage in designing and developing new dental technology in groups of dental and non-dental student. **Methods:** A customized survey has been sent to dental students and dental hygiene students in all classes in fall 2016. Another customized survey will be sent to engineering students in different sub-disciplines. The survey will ask about their interest in cooperation with each other and the possible skills they can offer to the group. Students who are interested in being contacted regarding the projects will receive an additional survey to further determine the potential of their cooperation. **Results:** The results suggests majority of USC dental school and USC engineering students are interested in working together as a team towards developments in new dental technology. **Conclusion:** The interest in dental and non-dental students of USC to work together as a team towards developments in dentistry is a unique potential to provide the basic needs for training and supporting more inventors in the future, and to be an efficient way to resource research and innovations for USC.

Poster #: 139

Title: Comparative performance of composite-resin inlays vs. short-fiber reinforced direct restorations

Name: Tan Khuu

Faculty Advisor: Pascal Magne

Background: Restoring large MOD defects can be challenging due to polymerization shrinkage stresses. **Purpose:** To compare mechanical performance and enamel-crack propensity of direct, semi-direct, and CAD/CAM approaches for large MOD composite resin restorations. **Methods:** 45 extracted maxillary molars underwent standardized slot-type preparation (5-mm depth and bucco-palatal width) including immediate dentin sealing (Optibond FL) for the inlays (30 teeth). Short-fiber reinforced composite resin (EverX Posterior covered by Gradia Direct Posterior) was used for the direct approach, Gradia Direct Posterior for the semi-direct, and Cerasmart composite resin blocks for CAD/CAM inlays. All inlays were adhesively luted with light-curing composite resin (preheated Gradia Direct Posterior). Shrinkage-induced enamel cracks were tracked by transillumination photography. Cyclic axial isometric chewing (5-Hz) was simulated, starting with a load of 200N (5,000 cycles), followed by stages of 400, 600, 800, 1000, 1200, and 1,400N (maximum 30,000 cycles each) until fracture or to a maximum of 185,000 cycles. Survived specimens were subjected to fatigue-to-failure test at 30-degree angle on the palatal cusp. **Results:** Shrinkage-induced cracking rates were 47%, 7%, and 13% for direct, semi-direct, and CAD/CAM inlays, respectively. Survival to accelerated fatigue was similar for all three groups (Kaplan Meier $P > .05$), ranged between 87% (direct) to 93% (semi-direct, CAD/CAM). Similarly, fatigue-to-failure test values did not differ significantly (Life Table analysis, $p > .05$) at 1,775N, 1,900N, and 1,675N, respectively. **Conclusion:** All three restorative techniques yielded excellent mechanical performance above physiological masticatory loads. Direct restorations performed as good as inlays when a short-fiber reinforced composite resin base was used.

Poster #: 140

Title: Distalization of ectopic maxillary molars with modified Nance/Halterman appliance

Name: Ramin Rabii

Faculty Advisor: Julie Jenks

Background: The most frequently found ectopic teeth are the maxillary first permanent molars and canines. An ectopic eruption of a permanent maxillary first molar may result in the need for orthodontic treatment in the future. **Purpose:** To explore the effect of Modified Nance/Halterman arch on treating ectopic maxillary first molars. **Methods:** Modified Nance arch was applied to a clinical cases with ectopic maxillary first molar erupting with a mesial inclination. First, a button was bonded on the occlusal surface of the first permanent molar. Modified Nance/Halterman appliance was then placed and the location of the hook was distal to the first molar. A power chain was placed to distalize the first molar. **Results:** The two maxillary first molars were fully erupted in their right position, with normal pulp activity and gingival morphology. No obvious root resorption was detected. The mean treatment time was 2 months. **Conclusion:** Modified Nance/Halterman appliance has advantages in treating ectopic permanent first molars.



Poster #: 141

Title: Seating accuracy of bonded restorations luted with preheated composite resin

Name: Mehrdad Razaghy

Faculty Advisor: Pascal Magne

Background: Preheated composite resin has been suggested as a luting agent for inlays, onlays, and overlays, but concerns remain regarding incomplete restoration seating due to its viscosity. **Pur-**

pose: To evaluate vertical seating of CAD/CAM composite resin inlays, onlays, and overlays luted with two different composite resins. **Methods:** Sixty plastic Typodont molars were prepared for medium-size MOD inlays, anatomic onlays, and flat overlays (N=20/group); 3-mm thick at the central groove with similar morphology (Cerec biogeneric-copy). Restorations were milled using Lava Ultimate blocks and included standardized hemispherical occlusal concavity for seating measurements with an electro-mechanic system (force=30N). Restorations were luted either with preheated composite resin (Filtek Z100) or dual-cure resin-cement (RelyX Ultimate). Seating of restorations were evaluated at baseline (try-in), after air-abrasion, after luting-agent seating, and after light-polymerization. Groups were compared using Kruskal-Wallis and Mann-Whitney tests. **Results:** Seating differences varied significantly from baseline. All restorations seated 3.85µm (inlays) to 5.45µm (onlays) deeper after air-abrasion. Except for cement-luted inlays, the try-in position ($\pm 1\mu\text{m}$) was recovered following luting. After polymerization, onlays and overlays seated 2.9–3.9µm deeper than try-in using Z100 and 7.0–7.3µm deeper using RelyX. Inlays luted with RelyX seated 7.9 (unpolymerized) to 7.7µm (polymerized) higher than try-in, whereas ones luted with Z100 seated within $\pm 1\mu\text{m}$ of baseline. **Conclusion:** Air-abrasion significantly deepens the seating of CAD/CAM composite resin restorations but the presence of the unpolymerized restorative composite resin luting-agent compensates this discrepancy. Following polymerization, onlays and overlays seated deeper compared to inlays, especially when using RelyX Ultimate cement. RelyX Ultimate, however resulted in higher seating of inlays.

Poster #: 142

Title: Influence of Symmetry and Balance on visual perception of the smiles

Name: Pullad Salem

Faculty Advisor: Pascal Magne

Background: This study will provide information on how the general public and dentists perceive the different smiles that have been

altered using fundamental criteria of natural oral aesthetics, and rank them as to what they believe are important factors in a beautiful smile. **Purpose:** This study is aimed to investigate how individuals perceive a smile based on fundamental criteria's of natural oral aesthetics. **Methods:** A survey was created containing images with altering factors that affect the patient's overall smile. 100 people participated in the study numbers of which were trained dentist. Analyses of these individual responses were recorded in response to various images that vary in alterations of the patient's smile. **Results:** Results will be provided in March as our research is still in process. **Conclusion:** Conclusion will be provided in mid March.

OTHER AFFILIATED RESEARCH

Poster #: 143

Title: The role of hedgehog-responsive cells in facial nerve regeneration

Name: Gabriela Bobarnac Dogaru

Faculty Advisor: Jon-Paul Pepper

Background: Facial nerve paralysis is a significant cause of morbidity, affecting speech, oral competence, vision, and emotional expression. Previous studies have begun to investigate the cellular events that occur during nerve regeneration, in hopes of finding molecular therapeutic targets to improve this process. Increasingly, non-neural cell lineages are recognized as having critical roles in the process of nerve regeneration, but the signaling pathways that drive these cellular responses are not fully understood. The Hedgehog signaling pathway has been shown to mediate complex multicellular responses to tissue injury in multiple tissue types. We therefore sought to characterize the behavior of hedgehog responsive cells following transection of the facial nerve. **Purpose:** To explore the role of hedgehog-responsive (Gli1+) cells in a mouse model of facial nerve transection and subsequent regeneration. **Methods:** We used a transgenic mouse line with an inducible reporter for lineage tracing of Gli1+ cells (*Gli1-CRE;tdTomato*) and

induced a unilateral facial nerve cut injury, using the contralateral side as an uninjured control. We analyzed the nerve via immunohistochemistry at 1 day, 1 week, 2 weeks, and 4 weeks after injury. **Results:** There was a significant increase in Gli1+ cells both at the site of injury and within the distal nerve segment. Preliminary results show a subpopulation of these cells to be NG2+ fibroblasts that contribute to the regeneration process via production of the pro-angiogenesis factor VEGF-A. **Conclusion:** The above finding describes a key signaling pathway by which fibroblasts participate in motor nerve regeneration. Intraneural fibroblasts may represent a previously overlooked therapeutic target.

Poster #: 144

Title: AMOR in the repair for gingival recession defect

Name: Courtney Cho

Faculty Advisor: Seiko Min

Background: Gingival recession (GR) causes many problems such as dentin hypersensitivity, impaired esthetic, root caries, gingival discrepancy, and attachment loss. The ultimate goal of root coverage is not only to cover gingival defects but also to regenerate periodontal support apparatuses. **Purpose:** This preclinical study sought to evaluate the efficacy of Antibody Mediated Osseous Regeneration (AMOR) to mediate periodontal regeneration on GR defects treated with a coronally advanced flap (CAF) in canines. **Methods:** Miller class II gingival recession defects were surgically induced on the labial side of maxillary canine in 8 dogs. The defects were randomly assigned to receive either anti-BMP-2 mAb (AMOR group) or iso type matched control mAb (Iso group). 12 weeks after surgery, the animals were euthanized for histologic and histomorphometric analysis. Silicone impressions were obtained at immediately and 12 weeks post operative for volumetric analysis. **Results:** The amount of linear root coverage in AMOR group and Iso group was $2.4 \pm 1.2\text{mm}$, and $2.1 \pm 0.9\text{mm}$, respectively. The amount of augmented soft tissue volume in AMOR group and Iso group was $6.6 \pm 5.1\text{mm}^3$, and $7.0 \pm 3.2\text{mm}^3$,

respectively. However, no significant difference was observed at 12 weeks. Histomorphometrically, the amount of new cementum and bone height were comparable among groups. **Conclusion:** Within the limitation of the present study, it can be concluded that application of collagen membrane functionalized by anti-BMP-2 mAb in conjunction with CAF may represent promising result but not for periodontal regeneration for treating GR defect.

Poster #: 145

Title: 3D microCT analysis of the mandible and maxilla development

Name: Thach-Vu Ho

Faculty Advisor: Yang Chai

Background: Craniofacial abnormalities such as mandibular dysmorphogenesis and maxillary hypoplasia are observed in multiple syndromes. Micrognathia in Pierre Robin sequence, for example, causes airway obstruction and cleft palate. However, the mechanisms of regulating craniofacial bone development are poorly understood. **Purpose:** To generate genetically engineered mouse models for understanding cellular mechanisms of mandible and maxilla development. **Methods:** We used 3D microCT to analyze the mandible and maxilla of *Mxsl^{-/-}*, *Wnt1-Cre;Tgfb²*^{fl/fl}, *Wnt1-Cre;Alk5^{fl/fl}*, and control mice at E18.5 and post-natal day 0 (P0). We used the Avizo software to label the mandible and maxilla and compared the differences between controls and mutants using morphometric analyses. **Results:** Morphometric results showed that the mandible and maxilla of *Wnt1-Cre;Tgfb²*^{fl/fl} and *Wnt1-Cre;Alk5^{fl/fl}* are significantly smaller than controls at E18.5. There was not a significant different in volume of the mandible and maxilla between *Mxsl^{-/-}* mutants and controls. **Conclusion:** These data suggest that *Tgfb²* and *Alk5* play an important role in the mandible and maxilla development. There was not a significance between *Mxsl^{-/-}* mutants and controls, suggesting that *Mxsl^{-/-}* may not be a key player in the mandible and maxilla development. Further studies are need to fully understand the mandible and maxilla development in these mouse models.

Poster #: 146

Title: Sutures possess strong regenerative capacity for calvarial bone injury

Name: Zoe Johnson

Faculty Advisor: Yang Chai

Background: Mechanisms during bone tissue remodeling and regeneration have previously been thought to be the same in long bones and craniofacial bones. Studies have shown that the periosteum and, in calvarial injuries, the dura contribute osteocytes and chondrocytes to the defect. Based on those findings, injury repair of the calvarial bone should be evenly distributed. We propose that Gli1+ MSCs found in the cranial suture mesenchyme are responsible for injury repair in calvarial defects and that their localized distribution will affect injury repair potential. **Purpose:** To investigate the role of Gli1+ mesenchymal stem cells (MSCs) from the cranial suture mesenchyme in injury repair of calvarial defects. **Methods:** A dental drill (burr size 1.8mm) was used to create three defects: one directly on the suture, one near the suture on the parietal bone, and one farther away from the sagittal suture on the parietal bone. Extreme care was taken not to damage the dura below. Gli1+ cells were detected using EdU staining. **Results:** After one month of healing, the injury made directly on the sagittal suture was completely healed and was indistinguishable from the surrounding uninjured bone. The other defects failed to heal completely. The farthest defect from the suture healed the least of the three injuries. Gli1+ cells from the suture mesenchyme quickly responded to injury and migrated to the defect to aid healing. Non-suture calvarial bone did not have this capability. **Conclusion:** Gli1+ mesenchymal stem cells in the calvarial suture contribute to, or are responsible for, injury repair. Their localized distribution causes healing of calvarial bones to progress unevenly, which possibly provides an explanation for the occurrence of critical-sized defects. We plan to investigate this aspect of injury repair in large animal models.

Poster #: 147

Title: D1 and D2 deficiency trends pre-doctoral dental educa-

tion classes 2015-2018

Name: Jennifer Jordan

Faculty Advisor: Mahvash Navazesh

Background: Responding to changes in technology, student need, national and state board examination, and evolving accreditation standards, the pre-doctoral dental program has progressed from a Problem-Based Learning (PBL) pedagogy, to an integrated Learner-Centered (LC) model, utilizing PBL group learning and pre-clinical module experiences in D1 and D2. Allowing for curricular changes 2005-2010, the pre-doctoral dental classes of 2015 to 2018 share the most comparable curriculum models for assessment. **Purpose:** This study aims to reveal student deficiency trends in the biomedical, behavioral or pre-clinical components of the program, using admissions parameters, including ethnicity, gender, age, educational background, pre-dental GPA or performance on standardized exams, and their relationship to achievement of on-time graduation, 1st attempt pass on National Board Dental Exams Parts 1 or 2, and WREB. **Methods:** Data includes admission demographics, scores for D1 and D2 DPBL Structure, Function and Behavior (SFB), and pre-clinical modules (PCM). Population includes pre-doctoral dental classes 2015 – 2018 (N=578), and assesses a sub-group of students with deficiencies (N=62), in trimesters 1 - 6. This sub-group represents 10.7% of the population. **Results:** SFB and PCM deficiencies are in a declining trend, with rates decreasing from 21% to 5% of the class population. Declining trends are also present, in this sub-group, with 1st attempt fail rates NB1 decreasing from 7% to 0%, and NB2 decreasing from 9% to 2%, and WREB decreasing from 3.47% to 3.45%. Late-grads also present a declining trend, decreasing from 10% of the eligible class population to 5%. **Conclusion:** Deficiencies among all groups (ethnicity, gender, age, educational background, undergrad GPA, DAT) are in decline.

Poster #: 148

Title: Runx2 is critical for homeostasis of the skull

Name: Diana Lopez

Faculty Advisor: Yang Chai

Background: Bones in the calvaria ossify through intramembranous ossification, in which mesenchymal stem cells directly differentiate into osteoblasts. Gli1+ MSCs within the suture mesenchyme differentiate into osteoblasts at the osteogenic front. Runt-related transcription factor-2 (Runx2) is required for intramembranous ossification in the skull during development; it plays a key role in osteoblast differentiation. Previous reports have demonstrated that in *Runx2* mutant embryos no calcification takes place. However, the role of Runx2 in post-natal development and bone homeostasis remains unclear. **Purpose:** To examine the role of Runx2 in the homeostasis of mouse skulls. **Methods:** Conditional knockout *Gli1-CreER;Runx2^{fl/fl}* mice were generated and injected with tamoxifen at one month of age in order to examine the function of Runx2 in the homeostasis of calvaria. MicroCT was used to compare the size and bone density of mutant and wild type mouse skulls. Histological analysis was also performed. **Results:** The overall size of the skulls appeared unaffected after the loss of *Runx2* in Gli1+ cells in *Gli1-CreER;Runx2^{fl/fl}* mice. MicroCT analysis revealed bone formation was enhanced in mutant mice with increased bone density. However, there was no change in cell proliferation activity or osteoblast differentiation in the skull bone. **Conclusion:** During post-natal development ablation of *Runx2* in the suture leads to the development of an osteopetrosis phenotype characterized by increased bone mass. Runx2 plays different roles during embryonic development and adult bone homeostasis.

Poster #: 149

Title: Cleft palate as a result of over-expression of *Beta-catenin*

Name: Davit Martirosyan

Faculty Advisor: Yang Chai

Background: Cleft palate is an oral malformation that results in a gap between the nasal and oral cavities. This can be due to failure of palatal shelf formation, fusion with the tongue or mandible, failure of proper fusion during palatal shelf elevation. **Purpose:** To observe the effects of the over-ex-

pression of *Beta-catenin* on the development and fusion of the palatal shelves during the embryonic development of mice. **Methods:** We are analyzing the effects of the over-expression of *Beta-catenin* in the cranial neural crest-derived cells via a *Wnt1-Cre* driver in mice at E13.5, E14.5, and E15.5. Mice carrying the *Wnt1-Cre* driver were mated with *Beta-catenin exon 3^{fllox/fllox}* mice, generating pups in which Beta-catenin is stabilized and overactivated. **Results:** The mutant mice exhibit an ectopic piece of cartilage protruding from Meckel's cartilage, which pushes the tongue up and prevents proper elevation of the palatal shelves, in turn causing cleft palate. The mutant mice also have a smaller calvarium as compared to the wild type. **Conclusion:** Further research is needed to verify these findings.

**Poster #: 150**

Title: Prognostic genes for predicting neuroblastoma outcome

Name: Satyajit Mitra

Faculty Advisor: Ruchi Bajpai

Background: When neuroblastoma is diagnosed <18 months, it is associated with high incidences of spontaneous regression. For the remainder, morbidity and mortality is significantly high. None of the gene signatures published to date have been incorporated into clinical stratification- or treatment - strategy as they offer no advantage over currently accepted criteria of age-of-diagnosis and MYCN-amplification. **Purpose:** Typically, when neuroblastoma diagnosis is confirmed, the patient is stratified into a low-risk or high-risk category dependent on age and MYCN-amplification. Irrespective of which dataset was analyzed and which form of induction and consolidation regimen was used in the high-risk patients diagnosed in these studies, these patients nearly always

died. Here we describe two gene signatures termed Survival Genes (SG) and Death Genes (DG) and link 155 new genes to neuroblastoma risk analysis. **Methods:** We retrospectively analyzed RNASeq expression data from neuroblastoma patients from the SEQC Consortium (n=498) and identified 161 Survival Genes (SG) and 112 Death Genes (DG) and validated our gene signatures in three independent datasets. Patients were grouped based on how many SGs (or DGs) they expressed that were greater than the corresponding survivor (or dead) median expression levels. We further stratified patient subsets that had MYCN amplifications or diagnosed >18 months and compared cohort arms by Kaplan Meier analysis and log rank test. **Results:** We identified 155 novel factors associated with neuroblastoma risk and formed two classifiers SG and DG that are powerful predictors of ultra-high OS and ultra-low OS respectively. In addition to stratifying the entire cohort, they can identify patients with poor prognosis within subsets of patients traditionally considered low risk groups-INSS2/3, diagnosed <18 months, or without MYCN amplification. Within the high-risk categories diagnosed >18 months and/ or containing MYCN amplifications, they identified patients at ultra-high-risk, 50% of who die within 25 months. **Conclusion:** Our newly discovered risk factors broaden the scope of neuroblastoma therapeutic strategies and can be used to identify neuroblastoma patients who may benefit from escalated or de-escalated therapy regimens.

Poster #: 151

Title: Virtual patient system for orofacial pain and oral medicine

Name: Luciano Nocera

Faculty Advisor: Glenn Clark

Background: We have built the DDS Detective game play and interaction to better teach dental students and postgraduate residents interview skills for diagnostic elaboration, incorporating lessons learned from our previous work, where we have used an autonomous virtual patient (AVP) system we created to examine and identify differences between novices and experts in dentistry with cases of Orofacial Pain and

Oral Medicine (OFPOM). **Purpose:** We present DDS Detective, a single player networked "serious game" simulation that allows dental students to interact with a set of standardized virtual patients and develop or improve competencies in making clinical decisions. DDS Detective game play mimics real-world patient-doctor interaction during interviews to provide a real-world like experience to help players learn to ask the right questions and make logical decisions. **Methods:** DDS Detective includes a unique case authoring system that allows to crowdsource OFPOM (game) cases. This has allowed to generate a large amount of content that is representative of a wide range of OFPOM pathologies that the students need to know how to diagnose and treat. **Results:** In this poster, we present our experiences and lessons learned in developing the DDS Detective system and its use as a summative competency examination at the Herman Ostrow School of Dentistry of USC. **Conclusion:** We further discuss future extensions and elaborate on how these results can be utilized in other domains.

Poster #: 152

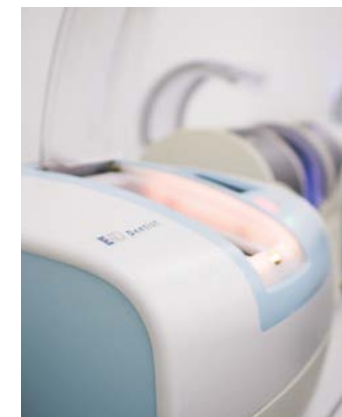
Title: *Ezh2* determines the molar root number

Name: Yeva Papayan Yeganyan

Faculty Advisor: Yang Chai

Background: EZH2 is a key component of polycomb repressive complex 2 (PRC2), which is responsible for Histone 3 Lysine 27 trimethylation (H3K27Me3). EZH2 is the subunit of PRC2 that catalyzes this methylation, leading to transcriptional repression of target genes. *Ezh2* is required for neural crest derived cartilage and bone formation. However, the role of *Ezh2* in tooth development is unknown. **Purpose:** We aim to elucidate the role of *Ezh2* in molar development and its function in patterning the tooth furcation. **Methods:** Four transgenic mouse models were generated in this study: *Osr2KI-Cre;Ezh2^{fl/fl}*, in which *Ezh2* expression is lost in the tooth mesenchyme; *DMP1-Cre;Ezh2^{fl/fl}*, in which *Ezh2* is knocked out in odontoblasts; *K14-Cre;Ezh2^{fl/fl}*, in which *Ezh2* is knocked out in epithelial cells; and *Gli1-CreER;Ezh2^{fl/fl}*, in which *Ezh2* is lost in root progenitor

cells. MicroCT scanning and histological analysis were combined to analyze the phenotypes of these mice. **Results:** When *Ezh2* expression was lost in the tooth mesenchyme in *Osr2KI-Cre;Ezh2^{fl/fl}* mice, only one root formed and the root furcation was defective. Moreover, the alveolar bone and periodontal ligament were also affected, whereas the development of the upper jaw appeared indistinguishable from control mice. In contrast, inactivation of *Ezh2* in odontoblasts, epithelial cells, and root progenitor cells resulted in normal furcation and molar development. **Conclusion:** Our study provides evidence that *Ezh2* determines the root number in mouse molars by determining the pattern of the furcation prenatally. Our future studies aim to identify critical downstream genes or signaling pathways that are associated with furcation development.

**Poster #: 153**

Title: Gene expression analysis of the mandible and maxilla

Name: Allan Wu

Faculty Advisor: Yang Chai

Background: Craniofacial morphology and dysmorphology is an important field for research for understanding both craniofacial development and congenital defects. One avenue from which it can be studied is through the gene expression in facial bones such as the maxilla and the mandible. As part of an ongoing research project within FaceBase, various different studies have been conducted that expand our understanding of facial bone development. Novel research about both functional genetic information and anatomical landmarks of the mandible and maxilla strives to explain the interplay between genetics and bone morphology. **Purpose:** The

purpose of this project is to generate heat maps highlighting cellular proliferation and the anatomical location of the mandible and maxilla. In this step of the process only wild type controls will be used. These heat maps will be a valuable tool to FaceBase users, and will be useful for comparison in future experiments with mutant models. **Methods:** Samples from E12.5 and E14.5 mice were collected via paraffin sectioning. Sections underwent immunostaining and image capture. Heat maps were generated via post processing using different imaging software. **Results:** We produced comprehensive gene expression data and heat proliferation maps of mice ages E10.5-E14.5 in mandibular and maxillary bone morphogenesis. These results will serve as the basis for comparative analysis in future experiments that use mutant models. **Conclusion:** Researchers can compare our heat map cell proliferation to their own data. This will facilitate understanding of specific signaling pathways during mandible and maxilla morphogenesis.

Poster #: 154

Title: *IFT88* is a candidate gene for human orofacial clefting

Name: Hua Tian

Faculty Advisor: Yang Chai

Background: Ciliopathies are pleiotropic human diseases resulting from defects of the primary cilium, and these patients often have cleft lip and palate. *IFT88* is required for the assembly and function of the primary cilia, which mediate the activity of key developmental signaling pathways. Through whole exome sequencing of a family of three affected siblings with isolated cleft lip and palate, we discovered that they share a novel missense mutation in *IFT88*, suggesting this gene should be considered a candidate for isolated orofacial clefting. **Purpose:** To investigate *IFT88* as a candidate gene for human orofacial clefting via *in vivo* studies in mice. **Methods:** In order to evaluate the function of *IFT88* in regulating craniofacial development, we generated *Wnt1-Cre;Ifi88^{fl/fl}* mice to eliminate *Ifi88* specifically in cranial neural crest (CNC) cells and *Osr2KI-Cre;Ifi88^{fl/fl}* mice, in which *Ifi88* is lost specifically in the palatal mesenchyme. **Re-**

sults: *Wnt1-Cre;Ift88^{fl/fl}* pups died at birth due to severe craniofacial defects including bilateral cleft lip and palate and tongue agenesis, following the loss of the primary cilia in the CNC-derived palatal mesenchyme. Loss of *Ift88* also resulted in a decrease in neural crest cell proliferation during early stages of palatogenesis as well as a downregulation of the Shh signaling pathway in the palatal mesenchyme. Importantly, *Osr-2K1-Cre;Ift88^{fl/fl}* mice exhibited isolated cleft palate. **Conclusion:** Our results demonstrate that IFT88 has a highly conserved function within the primary cilia of the CNC-derived mesenchyme in the lip and palate region in mice, and is a strong candidate as an orofacial clefting gene in humans.

Poster #: 155
Title: C-DOCTOR: Promoting innovations in dental & craniofacial regenerative medicine
Name: Bridget Samuels
Faculty Advisor: Yang Chai

Background: C-DOCTOR represents a partnership among several California universities and is

funded by the NIDCR to recruit, support, and accelerate the development of innovative tissue engineering/regenerative medicine technologies for the dental/oral/craniofacial region towards Phase I clinical trials. **Purpose:** To identify areas in which tissue engineering/regenerative medicine technologies are most needed in the dental, oral, and craniofacial complex. **Methods:** Graduate students from USC, UCSF and UC Davis conducted interviews with 22 dentists of a variety of specialties to determine areas of clinical need. The results of this survey will inform C-DOCTOR's priorities and pursuit of interdisciplinary translational project teams. **Results:** We identified bone (alveolar, jaw, and calvarial/suture), soft tissue, tooth structures, and periodontal tissue as the top four areas where tissue regeneration products are needed. **Conclusion:** Our vision is for C-DOCTOR to be a national resource for the clinical translation of innovative technologies to regenerate dental and craniofacial tissues and organs lost to congenital disorders, trauma, and

disease. Our primary mission is to provide comprehensive clinical, scientific, technical, regulatory, financial, and management resources to promote cost-effective transition and timely development of dental, oral, and craniofacial tissue engineering/regenerative medicine products.

Poster #: 156
Title: Rapid HIV testing at the Herman Ostrow School of Dentistry
Name: Maile Osborne
Faculty Advisor: Piedad Suarez-Durall

Background: There are an estimated 1.2 million people in America living with HIV, and 13% did not know they were infected. Early detection can prolong one's life quality, as well as decrease the spread of infection to others. **Purpose:** This study presents the results of rapid HIV testing at our dental school clinic. **Methods:** Patients waiting for a dental hygiene appointment were offered the opportunity of receiving a free HIV test using the patient's oral fluid. Those declining the test were asked to complete an anonymous questionnaire collecting demographics and

reason(s) for declining. The study was approved for human research (IRB #UP-13-00287). **Results:** Of 810 patients surveyed, 492 people declined to receive the test citing: just didn't want test today (60.16%) and already been tested (12.2%). Of the 318 tested, 3 (0.94%) were reactive with 2 of those also positive and one refusing the 2nd test. There were no significant differences by gender between people accepting/declining the test, however patients declining the test were more likely to be older ($p=.008$). **Conclusion:** The population seeking dental treatment in a dental school clinic are receptive to receiving a free rapid HIV test. The reactive rate of 0.94% in the school as compared to the 0.018% incidence rate in Los Angeles, indicates that testing for new undiagnosed patients is needed and that a dental school clinic provides an important non-traditional site for patients to be HIV tested.



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FROM
THE EDITORS



Dear fellow students, faculty, and staff,

It is with great pride and honor that we present the ninth edition of The Explorer. It features new and innovative research being pursued at the Herman Ostrow School of Dentistry, the Mrs. T.H. Chan Division of Occupational Science and Occupational Therapy, and the Division of Biokinesiology and Physical Therapy at USC.

We would also like to congratulate all of our fellow classmates in their accomplishments this year through their efforts in research. We recognize the hard work and dedication these students have made to keep this university at the forefront of science and hope everyone has the opportunity to support them during the poster viewing session. In addition, from restorative dentistry to stem cell research, we hope the projects displayed today as well as the lectures given by our keynote speakers serve as inspiration to those interested in pursuing research.

Lastly, we would like to thank everyone who has helped in organizing Research Day. It is the efforts of Dr. Yang Chai, Dr. Parish Sedghizadeh and the entire Research Day Planning Committee that have worked tirelessly to make today a success. We are also very fortunate to have an amazing group of writers, photographers, and leaders in Student Research Group without whom this journal would not be possible.

We hope everyone enjoys this issue of The Explorer and thank you so much for all the support.

Fight On!

Armin Afshar and Natalie Inoue

Front Cover Photo Credit:
Sarah Robertson - "Immunofluorescence image of PMCA1 (green) and PMCA4 (red) in the secretory stage enamel organ cells of a 9-day-old mouse mandibular incisor. Colocalization of PMCA1 and PMCA4 is shown in yellow on the basal and lateral membranes of ameloblast cells."

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Student Research Group (SRG) and
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