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FROM THE DEAN

Dear Ostrow Students and Colleagues:

Like nearly every other large in-person event this year, Ostrow's annual Research Day — typically one of my favorite days of the year — was necessarily canceled due to the ongoing coronavirus crisis.

But our intellectual curiosity and the imperative to continue scientific investigation can never be stymied, global pandemic or not. Research is the fuel for our professions, launching us into ever-exciting and sometimes unexpected directions. In fact, to be successful in your careers — whether that be in the dental, biokinesiology/physical therapy or occupational science/occupational therapy professions — you will need an almost insatiable thirst for new knowledge. You must constantly consume new research, learn new technologies and be willing to evolve the way you practice.

As part of a research-intensive university, we have always taken research very seriously. We are one of the only schools across the university to have an entire day devoted exclusively to research. In terms of funding, Ostrow has consistently been one of the nation's top-funded private dental schools by the National Institute of Dental and Craniofacial Research, a remarkable distinction that showcases the trust this agency has in our outstanding research community. Our colleagues at USC Chan currently have more than \$22 million in federal research funding, and the USC Division of Biokinesiology and Physical Therapy has secured nearly \$7 million in federal research dollars.

Even without our in-person Research Day, it was important that we showcased all of the hard work that went into this year's research posters. I want to congratulate all of our faculty and student researchers for the hard work, long hours and dedication it took to complete these research endeavors. I hope that you will take the time to really peruse this issue of *The Explorer* — not only to see what your colleagues are studying in your field but also what our colleagues at the USC Chan Division of Occupational Science and Occupational Therapy and the USC Division of Biokinesiology and Physical Therapy are doing to continue strengthening the science undergirding their professions.

And while it may be disappointing not to be able to have spirited discussions in person about these discoveries at the Galen Center this year, I am hopeful that we will be back at it very soon. I am also reminded that, if anything, the COVID-19 situation has underscored more than ever before the need to continue learning all we can about the world around us, so that we can prevent (or, at the very least, treat) needless human suffering through the discoveries we make in our labs.

Fight On!

Avishai Sadan, DMD, MBA

Dean

G. Donald and Marian James Montgomery Professor of Dentistry

INTRODUCTION TO RESEARCH DAY

Dear Ostrow Students and Colleagues,

Under normal circumstances, we would be welcoming you to the Herman Ostrow School of Dentistry's annual Research Day at the iconic Galen Center. Research Day is our annual celebration of the tremendous endeavors of our students, staff, and faculty in Dentistry, Occupational Science, Occupational Therapy, Biokinesiology, and Physical Therapy. This is my favorite event of the year because your inspiring work gives us a preview of USC's impact on addressing societal and health care needs. Although our event was canceled due to the ongoing pandemic, we are proud to present to you all the outstanding projects showcased in this year's Explorer.

It is our privilege as faculty to foster an environment for cutting edge research. Seeing students in our labs and clinics pursue novel research, perform new studies, and help each other are the favorite parts of my job. This year, more than ever, we have witnessed the dedication and resilience of our researchers despite the challenging circumstances during our city's stay-at-home orders and shutdown. As a major research university, we are grateful to have been able to safely continue research at USC during this pandemic. Your work ethic and perseverance to complete your studies during this unprecedented time inspire all of us.

Our supportive culture, which has been especially evident in these past months, makes USC a rich environment for interdisciplinary collaborations. We are committed to providing the best possible opportunities for you. The research experience and clinical training you receive at USC promote critical thinking skills for advancing scientific knowledge. Introducing students to the joys and challenges of research is crucial for innovation and discovery at USC and will ultimately benefit our society.

Please enjoy this issue of The Explorer. In these pages you will find very exciting and innovative research abstracts as well as articles highlighting some of our remarkable faculty members at the Herman Ostrow School of Dentistry of USC. To all the researchers represented here: you are the future of our profession, and your outstanding discoveries make it clear that the future is bright. I look forward to celebrating your research accomplishments together in person in the future.

Fight on!

Yang Chai, DDS, PhD

University 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



Disassembling the Mystery of Microcephaly

Yoojin Kim & Sumi Chung



Dr. Wei Zhang is a postdoctoral research associate in Dr. Jian-fu Chen's laboratory at the Center for Craniofacial Molecular Biology (CCMB) on USC's Health Sciences Campus. Dr. Zhang's interest in research started in China, where he received national scholarships for his exceptional passion in academia. He received his Bachelor of Science in applied biological science and technology at Anhui Agricultural University in Hefei, China and a PhD in biochemistry and molecular biology at China Agricultural University in Beijing, China. During his time

at China Agricultural University, his research focus was on porcine induced pluripotent stem cells (iPSCs). He studied the porcine iPSCs' long non-coding ribonucleic acid molecules (RNAs) and their significance in transcriptional regulation, which offered a new perspective on the mechanisms that control iPSC reprogramming. Furthermore, he investigated the important role of lipid metabolism in murine iPSCs to understand the mechanisms that underlie embryonic stem cell derivation.

To further pursue his dedication to research, Dr. Zhang decided to travel across continents to join the Chen lab almost three years ago. At USC, his work focuses on understanding the molecular mechanism behind human neural developmental disorders such as microcephaly. He uses a wide variety of techniques in the laboratory, integrating insights gleaned from human brain organoid and mouse models to shed light on human disease.

In particular, Dr. Zhang studies mutations in the gene WDR62, which represents the second most common cause of human microcephaly. He generated a Wdr62 knockout mouse model and WDR62-deficient human cell line to study the mechanism of the gene's effects. Dr. Zhang was able to discover that microcephaly is caused by neural progenitor cell disruption due to a WDR62 mutation and he was able to find similarities between mice and humans in how these effects manifest. Furthermore, since WDR62 plays a role in centrosomes and cilia, two important parts of a cell's machinery that are involved in cell division and the regulation of the cell cycle, Dr. Zhang focused on the effects of WDR62 mutations on cilia assembly. He discovered that WDR62 mutations not only cause spindle assembly defects, but also cause cilia assembly defects. As a result, longer cilia are produced, which hinder neural progenitor cells from re-entering the cell cycle. This then results in more cell death and premature neural differentiation, which in turn leads to microcephaly.

In this work, Dr. Zhang utilized a mouse model and human brain organoids, which are created by carefully culturing human induced pluripotent stem cells, because there is a considerable difference between mouse cerebral cortex and human cerebral cortex.

The human brain is more complex and has a special stem cell population called the outer radial glia (oRG) population, which is very limited in mouse cerebral cortex. Thus, disrupting oRG by mutating WDR62 in the human cerebral cortex resulted in a more significant reduction in human organoids than in mouse. By using both models, Dr. Zhang was able to capture this crucial difference.



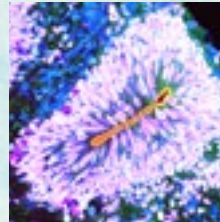
Bright field image of brain organoid (6 weeks of growth)(Image/Wei Zhang)

Dr. Zhang is currently focusing on studying other gene mutations that cause microcephaly. He hopes to understand the mechanism of gene mutations beyond WDR62 that cause microcephaly with mouse and human-derived models and ultimately devise therapeutic strategies for this devastating developmental disorder.

In October 2019, Dr. Zhang spoke at the Society for Neuroscience conference in Chicago on his paper published in Nature Communications. He was also selected to present his work for the principal deputy director of the National Institutes of Health, Dr. Lawrence Tabak, who visited USC in May.

Dr. Zhang would like to focus on investigating the neural activities of neural progenitor cells, as many human mental diseases are related to neural activities.

He will continue to utilize mouse and human brain organoid models simultaneously in order to study defects in neuron function; however, culturing human brain organoids can take from six months to a full year, which has been a big challenge for past studies of neural progenitor cells. Despite this obstacle, this is a direction Dr. Zhang would like to go. Eventually, Dr. Zhang hopes to further his scope of research by incorporating his current research with porcine models, which show a greater resemblance to human models than mice do.



Immunofluorescence of brain organoid section

Cilia (red) was observed in the ventricular zone (violet) of human cerebral organoid. Researchers study a role for cilia in microcephaly and its involvement during human brain development. (Image/Wei Zhang)

Dr. Zhang sincerely expresses his gratitude and excitement to be part of CCMB at USC. When asked what key factor motivates him during his research, he was confident in naming his principal investigator, Dr. Chen, and his team as his driving force. With the triad of Dr. Chen's direction, leadership and supportive environment, Dr. Zhang won the CCMB poster award in 2019. It is clear that he will continue to thrive in his field of research.

A Bio-Inspired Interface for Osseointegration

Mirza Baig and Joseph Leem

Dr. Yan Zhou is a researcher and Associate Professor at the Herman Ostrow School of Dentistry. He was born in China where he studied genetic engineering and upon graduating served as a research assistant at the Chinese Academy of Sciences. His drive and inquisitive nature drove him to come to the United States for graduate school at Indiana University where he began his graduate studies in cellular and developmental biology. After two years at the university, he transferred and took his talents to USC where he studied transcriptional regulation of the gene amelogenin, which encodes a protein responsible for enamel formation during development. Following the completion of his doctoral work, he began a post-doctorate in the field of bioinformatics before joining USC as a faculty member. One line of Dr. Zhou's work focuses on the odontoblastic potential of a splicing variant of amelogenin.

Despite ameloblasts and odontoblasts having different developmental origins, the second most abundant protein, which is 59 amino acids in length, produced by amelogenin splicing can also be expressed by odontoblasts. The genetic sequence that encodes this protein was synthetically produced and injected into mice, resulting in a mineralization effect similar to the effects of BMP, promoting bone formation.

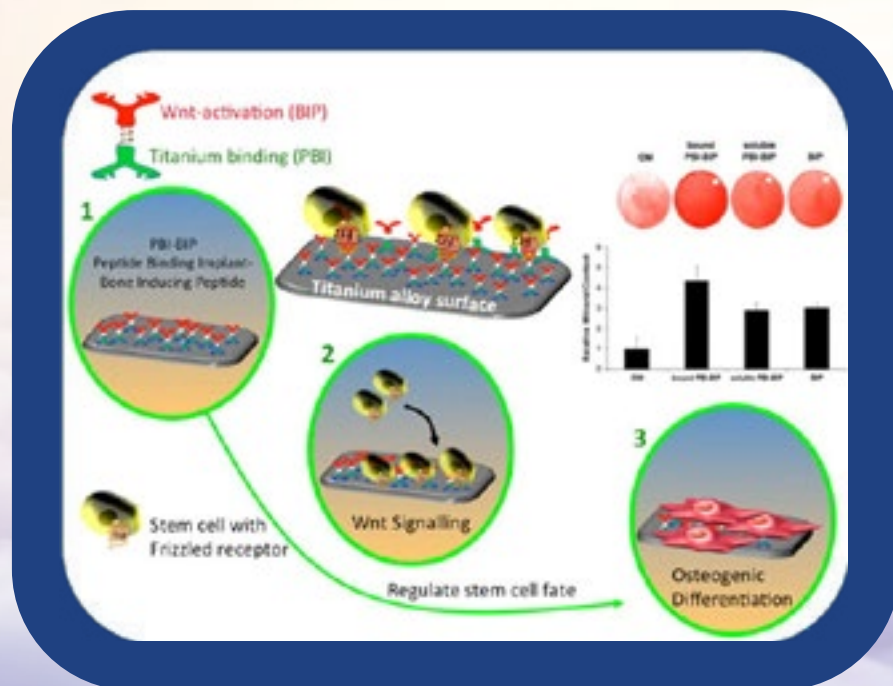
Shortly after joining USC, Dr. Zhou continued his pursuit of furthering the understanding of how this amelogenin splicing variant is capable of producing odontoblastic gain-of-function results such as increasing certain the expression of certain genetic markers, enhancing mineral deposition, and ultimately, increasing osteogenic differentiation in host systems leading to a 30-40% increase in bone mass in long bones. The results were surprising and cutting edge. Dr. Zhou confirmed his findings by producing loss-of-function models by deleting the amelogenin locus in mouse embryonic stem cells. When the gene was removed from the cell line, osteogenic differentiation potential was impaired. Transgenic mouse models were then produced to confirm the potential of this gene. Bone mass density and bone marrow content from these mice were then compared to wild type controls. Significant results were found with the transgenic mice having much stronger osteogenic potential in terms of differentiation and mass.

In the future, this molecule holds enormous potential for clinical application, where it is highly desirable to be able to promote and control osteogenesis. Dr. Zhou hopes that dental implants may be used as a model system to improve osseointegration of implants throughout the body, as in orthopedic applications. The current most common complication with dental implants is their inability to properly integrate with the surrounding alveolar bone, leading to peri-implant disease and bone loss around the implants. Working with a researcher from the University of Kansas who discovered a 12 amino acid peptide which has a strong specificity and affinity for titanium, Dr. Zhou saw a promising future for implant patients. His team fused the 12 ami-

no acid peptide with the 59 amino acid peptide which was created by the splicing variant of amelogenin and coated the titanium surface of the implant with this dual-function protein. The protein showed a strong affinity for binding to the titanium surface and had an osteogenic effect on the surrounding tissue. This was a breakthrough in Dr. Zhou's research because it showed how this protein could significantly improve the osseointegration of implants.

Additionally, he hopes in the future, this protein will be a part of normal maintenance for patients with implants who, along with their scheduled cleanings, will also have their implants coated with this material by their provider to maintain and encourage bone regeneration around the implants. He also mentioned the possibility of introducing other molecules on to the surface of the implant, which would provide anti-microbial properties and improve the overall oral health of the patient. With the increased use of devices such as implants, Dr. Zhou's research is at the forefront to ensure the proper integration of these devices with the body.

Molecular recognition based self-assembly is coupled with biochemical signaling to reprogram stem cells to osteogenic lineages at the implant interface. A bio-inspired interface utilizes a chimeric peptide composed of bi-directional domains: one domain self-assembles onto implant materials and another transiently activates the canon-



ical Wnt signaling pathway to stimulate osteogenic differentiation. During a period critical to host stem cell growth and determination, bioactive interface signals serve to activate mouse or human stem cells to differentiate along osteogenic lineages. This engineered approach mimics nature's ability to design dynamic interfaces promoting bone regeneration.

The Future of Night Guards

Ava Pournajad and Sarah To



Dr. Glenn Clark, Director of the Advanced Program of Orofacial Pain and Oral Medicine and the Assistant Dean of Distance Education at the Herman Ostrow School of Dentistry of USC, is one of the university's premier faculty. He is a distinguished author, having published four books, 23 book chapters, 162 abstracts and 205 peer-reviewed journal articles. His prolific output represents his distinguished work in research. Dr. Clark is currently busy with several research projects, each carrying significant clinical potential.

One of his research interests is the common problem of sleep-related bruxism, the involuntary clenching or gnashing of the teeth at night. If habits of bruxism remain unresolved, severe damage to the teeth, nerves, temporomandibular joints and muscles of the mouth may result. The current standard for treating bruxism is prescription of a night guard. Night guards help mitigate damage, but the success rate for such appliances is quite low if the goal is to stop bruxism. As Dr. Clark emphasizes, "a simple piece of plastic will not resolve the problem" of years of hard-wired habits of severe grinding. Instead, he proposes the use of a "vibration splint" that provides stimulatory feedback in response to clenching. The vibrations are intended to directly stimulate the mechanoreceptors of the trigeminal nerve in an effort to alter motor events without causing significant sleep disturbances. Such an appliance would suppress the behavior as well as encourage the individual to become

more aware of it, thereby increasing the probability of breaking grinding habits.

The original idea for such a tool was an electrical lip stimulation device. However, while walking the Akihabara district of Tokyo in Japan, Dr. Clark and his colleague, Dr. Kazuyoshi Baba, professor of prosthodontics at Showa University, serendipitously found a box of old cell phone buzzers at a storefront. This initiated the innovation to create a vibrating splint. Since that day, Dr. Baba, his team at Showa University and Dr. Clark have collaborated to produce several generations of devices, working continually to improve the technology. The current generation of the vibration splint is custom-made and designed specifically for each patient. These guards are constructed using CAD-CAM technology and 3D printing. Within the appliance is a piezoelectric film used to detect occurrences of clenching/grinding and activate the vibrating device. A recording system is included to assess the duration of each clenching/grinding episode. Furthermore, a unique thermal system is implemented to monitor use. Patients can use the appliance as easily as a conventional night guard. They just wear it at night and upon waking, place it on a cradle that automatically downloads the data and recharges the battery. The hope is that this device will effectively treat sleep-related bruxism by resolving the root of the issue rather than simply masking the symptoms.

In addition to the vibrational splint project, Dr. Clark is currently developing an electronic “smart questionnaire” designed to help clinicians more accurately treat orofacial pain disorders by directing assessment along a course of refined differentials driven by the chief complaint. The inspiration behind this project is a motivation to address the frequent frustration of misdiagnosed orofacial pain. The project is currently in progress with collaborators including Dr. Yuka Abe, a visiting research scholar from Japan, and Dr. Luciano Nocera from USC’s Viterbi School of Engineering; it is also the thesis project for one of Dr. Clark’s current residents, Dr. Anette Vistoso.

The sensitivity and validity of the questionnaire rests upon a large foundation of clinical data that has been meticulously mined, analyzed from narrative notes and transformed into structured data. This data mining will allow Dr. Clark’s research group to develop a narrow AI smart questionnaire that uses built in algorithms and data analytics to detect one or more of the 25-30 conditions patients frequently present with.

When the patient completes the questionnaire, a set of probable diagnoses are then available for the clinician to consider and confirm or deny as they then interview and examine the patient. The group sees this questionnaire as an adjunct diagnostic aid that might someday even evolve into an app that clinicians could download to a mobile device. The construction of such a questionnaire would undoubtedly provide doctors with invaluable guidance towards providing better pain management and care to patients.

Dr. Clark is recognized as an invaluable asset to the Ostrow School. A brilliant researcher, teacher, mentor and winner of the 2018 USC Provost’s Mentoring award, he continuously innovates new methods to improve the quality of care for patients. He is an esteemed individual whom we ought to recognize and applaud!

Overview: Vibratory Stimulus Devices

Device	Experiment period	Product features
1 st generation (Watanabe et al. J Prosthet Dent, 2001)		Occlusal force detected by Code Switch
2 nd generation (Nakamura et al. Sleep Breath, 2019)		Immediate response, just after delivery
3 rd generation (Nakazato et al. under review for publication)		Immediate response, after 2 weeks adaptation
4 th generation (ongoing experiment)		Response of daily use, after 2 weeks adaptation

The Future of Biomaterials and Digital Dentistry

Catherine Frusetta &
Atysha Mohindroo

Progress is always made through fresh ideas, and fresh ideas come hand-in-hand with new researchers. The Herman Ostrow School of Dentistry of USC has recently begun a new program: the Master of Science in Biomaterials and Digital Dentistry (BMDD) program. Four candidates have spoken to The Explorer about their backgrounds, experience in research and how they will use their knowledge in the future: **Dr. Rie Hayashi, Dr. Mohammed Alshanbari, Dr. Mostafa Ibrahim, and Dr. Judy (Yun-Chu) Chen.**

They are all fulfilling a residency while pursuing their master's in BMDD at USC.

To earn an MS in BMDD, students must complete an original research project and a master's thesis while being overseen by an advisory committee. At this point in their degrees, these four candidates are in the beginning stages of forming a proposal for their research.



Dr. Rie Hayashi is a resident in the program in advanced operative and adhesive dentistry. She grew up in Japan and initially became interested in dentistry through her parents and brothers, who are also dentists. In 2012, she earned her doctorate of dental surgery at Aichi Gakuin University in Japan and completed a 2-year combined endodontics and periodontics program in Osaka, Japan. She then worked as a dentist in private practice before entering the USC Advanced Standing Program for International Dentists in 2016.



Dr. Mohammed Alshanbari is also a resident in the program in advanced operative and adhesive dentistry. As a child, he was surrounded by family in Saudi Arabia who were in the medical field, which inspired him to pursue dentistry. In 2011, Dr. Alshanbari earned his bachelor's degree in dental medicine and surgery at Ibn Sina National College for Medical Sciences in Saudi Arabia. He worked in various hospital clinics as a general dentist in Saudi Arabia and as a faculty member teaching public health at Umm AlQura University in Saudi Arabia. Dr. Alshanbari is no stranger to research because at Umm AlQura University he worked on research pertaining to the expression of antimicrobial peptides, beta defensins 1, 2 and 3 in gingival tissues of patients with type 2 diabetes. His research continued in California as he earned a master's degree in public health in 2018 at Loma Linda University, where he studied perceptions of breastfeeding and infant feeding habits and how they vary by location.

Dr. Mostafa Ibrahim is a resident in the advanced program in prosthodontics. He first became interested in dentistry because his sister and brother are both dentists. He graduated in 2006 with a bachelor's degree in dental surgery from the Baghdad University College of Dentistry in Iraq. He then went on to become a resident in advanced education in general dentistry, and afterwards a resident in oral and maxillofacial surgery in Baghdad, Iraq. Additionally, he was a clinical instructor for new graduate dentists in the oral surgery unit. After working in private practice in Iraq, he came to Ohio State University in 2016, where he worked as a visiting scholar in the restorative science and prosthodontics division. There he participated in research on dental materials, examining the bond strength at the interface between the teeth and base of dentures under conventional processing and under additional secondary heat above the glass transition temperature, specifically analyzing the strength of bonding between polymethyl methacrylate denture base and acrylic denture teeth.



Dr. Judy (Yun-Chu) Chen is also a resident in the advanced program in prosthodontics. She initially became interested in dentistry because she was attracted to the way that the field combines art and science. In 2014, she graduated as a doctor of dental surgery from the Taipei Medical University School of Dentistry in Taiwan. She practiced as a general dentist for two years while simultaneously studying as an endodontics resident at the National Cheng-Kung University Hospital in Taiwan. She moved to California in 2018 to begin her prosthodontics residency and subsequent master's at USC.

All of these young dentists hail from diverse backgrounds, yet they find themselves working alongside each other to study biomaterials and digital dentistry as they begin their proposals for their research projects.

The BMDD program provides dentists with specific knowledge in dental material properties and biological interactions of various adhesive systems, composite resins, ceramics, implants, 3D printing, digital scanning and computer-aided design/computer-aided manufacturing (CAD/CAM). It develops skills in cutting-edge digital technologies which will be more prevalent in the future.

According to Dr. Alshanbari, the students are currently being introduced to different printing materials with 3D printers and their applications, which has sparked all of the students' interests in the limitations of CAD/CAM.

The CAD/CAM laboratory opened at USC in 2014 and uses data from a patient's digital dental image to cut a customized restoration piece from a block of ceramic material. This machine uses an infrared scanner to capture a tooth preparation and translate it into a digital restoration which can be perfected manually by the user. The restoration is created with ceramic materials in twenty minutes. At this point, the dentist can then place the restoration on the patient's tooth. With CAD/CAM, a patient can have a crown prepped and placed within a single appointment. This could help reduce dental costs for both the doctor and the patient. However more research is being conducted on the limitations of CAD/CAM and our residents are interested in exploring this.

This academic path is very valuable to dentists everywhere. Dr. Chen reports seeking her MS in BMDD so she can have a more comprehensive understanding of dental materials. Dr. Alshanbari adds that knowledge of specific biomaterials is crucial to fully understanding different products and their effects, longevity and esthetics. Additionally, understanding digital dentistry, particularly CAD/CAM, is invaluable to moving into the future of dentistry and raising efficiency in a clinical setting.

While all the candidates are interested in investigating digital dentistry, their interests lie in different areas. Both Dr. Chen and Dr. Hayashi came into the program with no prior research experience and have voiced their

excitement at getting their feet wet. Dr. Chen wants to look into comparing the accuracy and performance of 3D printed dentures with conventional dentures, while Dr. Hayashi spoke about possibly exploring the minimal thicknesses of crowns allowable in CAD/CAM technology and the minimum prep that would be required for bonding such crowns. Dr. Alshanbari and Dr. Ibrahim are both interested in looking into the accuracy and precision of 3D printing. Dr. Alshanbari expressed his intention to look into measurements in temporary digitally printed crowns to test the accuracy of the printers.

The ideal result of research is implementation, and although it may take decades for new research to be successfully implemented in clinics, students can take the knowledge earned during their research and move on into their futures.

Dr. Hayashi wants to stay in California after graduating and start practicing as a private operative dentist. She enjoys talking to patients and refining esthetics, and fully intends to use the knowledge she has learned about dental materials and technology in the clinic. Additionally, her goal is to enhance dentistry in both Japan and America by being a bridge between the technologies of the two countries.

Dr. Alshanbari began this program because he wanted to learn a little "something from everything" through combining public health with dental expertise. He wants to go back to his home country, Saudi Arabia, and work

clinically while teaching dentists about the new advanced dental materials and techniques that he learned at USC.

Dr. Ibrahim's current plan for the future is to apply for a fellowship in maxillofacial and prosthetic dentistry. He wants to use his degree in digital dentistry to learn more about the fabrication of prosthetic ears, noses, and eyes. He is also interested in pursuing future research in the digital workflow for rehabilitation of maxillofacial prosthetic patients while simultaneously working clinically.

Dr. Chen is considering continuing in academia, focusing on digital dentistry in the future. She wants to gain some experience practicing in the United States and is also interested in teaching in either the United States or in Taiwan, her home country.

Biomaterials and digital dentistry are

subjects which every dentist would benefit to know more about, as they affect every specialization of dentistry.

Looking ahead, digital dentistry has limitless possibilities in the future of clinical practice and research, especially when considering 3D printing and CAD/CAM. All of the dentists interviewed have very different plans for the future, but they are all benefiting from gaining expertise in biomaterials and digital dentistry. They are choosing to take this degree and the results of their research to launch their careers in different directions. It will be interesting to follow what discoveries can be made in the hands of these promising doctors.

Dr. Rie Hayashi
(resident Advanced Operative & Adhesive Dentistry) and MS BMDD Candidate

Dr. Mohammed Alshanbari
(resident Advanced Operative & Adhesive Dentistry) and MS BMDD Candidate

Dr. Mostafa Ibrahim
(resident Advanced Prosthodontics) and MS BMDD Candidate

Dr. Judy (Yun-Chu) Chen
(resident Advanced Prosthodontics) and MS BMDD Candidate

"I always wanted to go into dentistry since I was young with braces," Parungao recalls, "getting that great smile, not being self-conscious and having good teeth always motivated me to be in this field."

Now, as an Assistant Professor of Clinical Dentistry at the Herman Ostrow School of Dentistry, Director of Field Operations for many of Ostrow's public health projects, and candidate for a Masters degree through USC's Community Oral Health (COH) program, Parungao is following through with her passion for public health dentistry.

Parungao cited some of her experiences as a volunteer with the pre-dental society at the University of California, San Diego (UCSD) that pushed her into getting her RDH degree at USC. With her RDH degree, she felt the need to continue her education by getting her RDHAP at UOP. As a former dental hygiene student at Ostrow, Parungao received further exposure to public health services, and even coordinated health fairs for her class. It was at USC where Parungao gained greater awareness of the need for dentistry and dental education in the community – she wanted to spread this knowledge, get people to dental homes, and provide dental education that a lot of communities needed. "USC has great programs and provided a lot of exposure that allowed me to understand what public health dentistry is about," says Parungao, "the courses and community health programs showed me my passion to want to continue and give back with public health."

Leading the Way

Since graduating from Ostrow in 2013, Parungao has continued her commitment to public health dentistry as a leader in the field. She currently serves as director of field operations for the Educational Community Health Outreach (ECHO) project and prior to that, she also served as a director for Children's Health and Maintenance Program (CHAMP), which concluded in 2017.

CHAMP is a First 5 LA funded project that started in 2012. CHAMP's mission was to connect underprivileged children ages 0-5 living in specific Service Planning Areas (SPA) of Los Angeles to long term dental providers (dental homes) in the adjacent areas. During her time with the grant, Parungao was organizing and sending 3-4 teams every day to preschools, health fairs, and Women, Infants, and Children (WIC) centers located in the designated SPAs. It was at these community outreach activities that the CHAMP team was able to not only identify underprivileged children and connect them to "dental homes," but also provide dental education and preventative screening.

But Parungao wasn't just assisting with organizing these visits, she is directly in the community as well providing services. She even sacrificed her weekends to increase the community's oral health literacy and further spur community development.

Faculty quickly applauded Parungao's passion and determination with public health dentistry.

"Public health field work is not easy," observes Dr. Roseanne

Education Community Health Outreach Started with a Smile

Brian Jing

Mulligan, Associate Dean of Community Health Programs and Hospital Affairs Chair at USC, "Not only does Kristine demonstrate her dedication to public health on a daily basis, but she also demonstrates such great organizational skills in keeping the multiple teams busy and productive, often serving as the spokesperson for our field work whether it is to parents and collaborative team members or colleagues at national meetings. She has been a real boon to our outreach efforts!"

The results of Parungao and the CHAMP team's reached over 63,000 children and over 33,000 children were able to find a dental home where case management was provided to over 70% of them. A network of 342 Family Outreach community sites was also established to continue the identification of underprivileged children and connect them to dental homes as well as provide dental services and oral hygiene education. CHAMP also recognized that non-health care professionals were being underutilized in the dental field and could greatly improve accessibility to dental care. USC social work interns helped address and eliminate common psychosocial barriers between these families and dental care. An astonishing 93% of families that were connected to social work interns resulted in successful case closure.

"What I've learned most is to give time back to the community," Parungao adds, "I'm passionate about this and the education of oral health since there's a deficiency of it."

Technology and ECHO

While CHAMP has since ended, Parungao has moved on as Director of Field Operations for ECHO, funded by the California Department of Health Care Services. In many ways, ECHO is an extension of CHAMP but with a broader target population. Similar to CHAMP, ECHO's main goals are to educate, screen and connect disadvantaged socioeconomic communities in certain SPAs of Los Angeles with dental homes. However, this project serves a larger population of the Los Angeles county – not only is ECHO catering to community members from ages between 0 and 20, but the project is also reaching out to disadvantaged minority groups such as the Native American population.

Still, Parungao is placing emphasis on yet another factor: Technology.

Parungao notes that we can "think outside of the box" in how health care professionals can reach underrepresented populations. With communities rapidly becoming more tech-savvy, Parungao believes that merging the digital world with health

services could be impactful. “Technology is not the same as before – people are now using smartphones and they download a lot of different apps that are related to their health that they want to improve,” comments Parungao. “One thing that the public health community can concentrate on is creating technology that targets different populations and age groups to help them increase in their oral health and help facilitate their questions so they get continued care more regularly and establish a dental home.”

As a member of the USC Steering team for the

ECHO project, Parungao is collaborating with other staff members to develop a mobile app tailored to connecting ECHO’s target populations with dental homes. At first, Parungao and her colleagues were concerned that these communities may not have smart phones. However, it was quickly proven to them that most do have access to smartphones. Plus, if lacking one, government run agencies would even provide these devices to members of these socioeconomic backgrounds for free or at a reduced cost.

The app has numerous features, from educational components to being a conduit for communication between these specific underprivileged patients and dental providers. Via the app, users can type out and send questions about their oral health condition to their dentist and receive responses back from their provider. “It’s like tele-health,” Parungao notes.

Furthermore, the app allows the ECHO team to gather information about the patient visits. “It allows us to capture information such as if they’re visiting their dentists and how well their visit went,” Parungao explains. The app also contains educational materials: common questions such as “when can my child use fluoride toothpaste” are answered in the technology. Parungao hopes the app can be piloted by this summer of 2020.

A Devotion to Learning

With her busy life, Parungao also manages to further enhance her knowledge and skills in the public health field as she is currently actively pursuing her Masters degree in COH at Ostrow. This community oral health online graduate program helps students prepare for a leadership role in community health. Parungao is developing a greater understanding of the social determinants of health, health equity, epidemiology, research methodology, program planning and evaluation, as well as health promotion. Perhaps most importantly, Parungao is figuring out new methods to efficiently handle the complex nature of managing community outreach programs via her research that she conducts in conjunction with her education. “In public health, you can participate in providing services but how does everything work? How do organizations get their grants and how do you implement a project from beginning to end? There are theories and different ways to implement different projects that have shown to work and continue to work in public health,” says Parungao. She finds it critical to apply these theories, increase knowledge in how to educate and reach communities, and discover efficient ways in gathering and interpreting data to better target communities in need. Parungao finds that the program is exposing her to a lot of different technological tools which can then be implemented in stronger methods of outreach.

Parungao has also found that the most efficient way in strengthening public health dentistry today starts with partnering up with organizations that can reach out to all types of communities. By working with organizations, public health

projects can target even more populations leading to greater overall oral health in the United States. “Reaching out to organizations to push our oral health message forward and connecting with communities is something we need to work on,” Parungao urges.

Parungao’s experience out in the field ties in all too well with her continuing education and vice-versa. “I use my experiences from CHAMP and ECHO and apply it to the COH research,” Parungao says.

Her Outlook on Public Health


Overall, Parungao is happy to see where the state of public health dentistry is going as there is an increase in awareness of oral health. However, Parungao feels that there is room for improvement. Health professionals not only still need to be more engaged with public health dentistry, but need to be more educated in oral health as well. “There is a big need for public health services and in order to eliminate a lot of the public health disparities that we’re seeing, it will require a bigger effort from our community of professionals to really provide to the communities that need it the most,” remarks Parungao. According to Parungao, there is a gap between health professionals and dentistry that needs to be addressed. The mouth is part of the body, not separate, which means that more attention needs to be paid to oral health to have greater understanding of the overall health of a person. Parungao suggests that physicians, nurses, and even students need to realize the connection between the mouth and body. “We have to pay attention to oral health, learn what oral health can do to the body, and really fill in that gap of knowledge between the mouth and body,” Parungao says, “if other professionals could increase their knowledge of oral health and recognize that there are barriers to oral health like the lack of resources to find transportation to see their dentist or dearth of knowledge on dental insurance, we can then begin to merge those gaps.”

Ultimately, Parungao feels that public health dentistry is often under looked and that there is an abundance of rewards in a career with public health. It also reminds professionals of why they got into a health service oriented career in the first place. “When you go through school for just dentistry, you’re missing a big aspect of public health. Providing to the community after you graduate is really important – at one point, we all want to give back,” Parungao says, “I’m really passionate about the people I work with and care for. If I can make a small difference in someone’s oral health, then there is something everyone can do.”

Parungao leaves a lasting message, inviting all to get active with public health and promote positive changes. “We’re all leaders and it’s important to take that extra step to make a difference. Heart is what makes a leader – you should have heart to give back and it’s the reason I continue down this path. Any way anyone can help, or anyone just willing to help is appreciated and will make a difference.”

Putting Tons of Smiles on Children's Faces

Jamie Huh & Meredith Messerle



Dr. Thanh Tam N. Ton is the Chief of Pediatric Dentistry at LAC+USC. Given her USC and Harvard training, it comes as no surprise that Dr. Ton is committed to a career in academia. Since completing her residency in pediatric dentistry in 2006 at the Children's Hospital of Michigan, Dr. Ton has worked in some capacity as a professor of clinical dentistry. Reflecting on her tenure as both a clinician and an instructor, Dr. Ton said, "when I graduated from my residency, I immediately worked part-time as a clinical professor. I continued to work in private practice for several years before transitioning to academia full-time. I enjoy teaching."

LAC+USC Medical Center's Pediatric Clinic was born out of a partnership with the Violence Intervention Program (VIP), a local advocacy group. It has since been subsidized by the Los Angeles County Department of Health Services and continues to provide comprehensive health care treatment to the community's most vulnerable children, including foster children and those with developmental disabilities. The clinic also serves as a training ground for the Herman Ostrow School of Dentistry of USC's advanced pediatric dental residents.

The pediatric clinic at LAC+USC allows Dr. Ton to teach and conduct research. She is currently conducting a survey for caregivers that will investigate the oral health knowledge of foster parents versus biological parents. Her hope is to improve outcomes for oral home care for children while addressing any discrepancies that might exist between foster and biological families.

Dr. Ton was the first in her family to become a dentist. A family friend who attended dental school at USC inspired her to follow a similar career path. "I didn't have a lot of dental experience prior to dental school, but I thought it would be a great profession to get into," she said. She applied to USC for her undergraduate education where she was accepted into the Accelerated Dental Acceptance Track (ADAPT) program. She went on to receive her doctor of dental surgery degree at the Ostrow School in 1999.

Prior to graduating from dental school, Dr. Ton faced a familiar dilemma: pursue general dentistry or specialize? She opted to complete a one-year Advanced Education in General Dentistry (AEGD) residency program, earning a certificate from the Harvard School of Dental Medicine in 2000. "I didn't have a clear path for what to do post-graduation," said Ton. "I thought the residency would give me more clarity." During this time, she realized how much she enjoyed working with children, and thus decided to specialize in pediatric dentistry. "The most rewarding part of dentistry is seeing the children smile and see them gradually become happy to go to the dentist," she related.

Aside from teaching, directing the pediatric clinic and conducting research, Dr. Ton spends her time participating in the admissions process at Ostrow. She has been an active member of the faculty, including serving as the vice president of the Dental Faculty Assembly. She has also served on the legislative committee for Los

Angeles Dental Society, the Society of Public Health and the California Society of Pediatric Dentistry. She is an active member of the Pediatric Directors Committee, Chiefs and Chairs Committee, Pediatrics Committee, Medical Executive Committee, and the OMFS Dental Workgroup at LAC +USC.

In her free time she volunteers as a pediatric dentist at service events like the Telemundo Health Fair, VIP Fetal Alcohol Awareness Health Fair and other VIP events, CDA Cares and Los Angeles Times Festival of Books. "My favorite service activity has been my work with the Violence Intervention Program where I conduct oral health screenings. I enjoy meeting and talking to people and interacting with the children and their caregivers to provide checkups and oral hygiene instruction," she said.

Dr. Ton also serves as a mentor for dental students and high school students interested in a career in pediatric dentistry. She mentors students through dental externships, the dental assisting internship at the Pediatric Dental Clinic and the USC Concurrent Enrollment Dental Assistant Program. Her advice for current dental students and prospective pediatric residents is "go and seek externships to get an idea of what residencies are like and if it is something you can see yourself doing in the future."

It seems like Dr. Ton can do it all. She enthusiastically proclaims, "I believe being passionate about what you do and enjoying what you do is a fundamental skill for every healthcare professional!" Nevertheless, she insists that she faces challenges when practicing dentistry. "Managing the behavior of children can be difficult at times," she notes. "Not all children like getting work done, and it is very testing to change their perception about the dentist." However, the most rewarding part of dentistry for Dr. Ton is when she finally gains the trust of her patients and puts smiles on their faces.

Overcoming Obstacles in the Dental Journey

Sepehr Hakakian

Dr. Yaara Berdan's path to dentistry is one that many dental students can relate to. She started out with a passion for the sciences and an interest in the healthcare field. After a discussion about her future career, she decided that dentistry would be the ideal choice. In addition to satisfying her passions for the biological and physical sciences and the biomedical field, the stable lifestyle that dentistry offered was attractive to the young Dr. Berdan. She laughingly notes that she ended up specializing in endodontics and pedodontics, two fields with the least stability due to the high number of unexpected emergencies that come with each.

Dr. Berdan attended UCLA as an undergraduate student, majoring in kinesiology. She dabbled in work as a personal trainer and thought about a career in physical therapy before starting dental school and the University of California, San Francisco (UCSF). She immediately fell in love with dentistry. One of the first things she noticed was the overwhelm-

ing scope of material there was to learn. "Knowing everything would be impossible, so I knew that I wanted to specialize after the first few weeks," she says. The first specialty she looked into was periodontics. This was not only because perio is the first specialty dental students are exposed to. As Dr. Berdan explains, "I considered perio because it's the foundation of everything. Without perio, everything would collapse very quickly."

After finishing her DDS degree at UCSF, Dr. Berdan did a pediatric dentistry residency at the Boston Children's Hospital. There, she realized that while she enjoyed working with children, her true passion was treating traumatic cases that often involved endodontic treatment. This realization led her to pursue a second specialty, endodontics, at the University of Illinois, Chicago. Just like countless other dental students, Dr. Berdan had to go through multiple specialties in order to find a career path that she felt satisfied in and wanted to pursue.

After moving back to Los Angeles, Dr. Berdan practiced as an endodontist for several years. Working in a multi-specialty office, she enjoyed collaborating with a team of specialists to deliver truly comprehensive care to patients and learning new things about other specialties on a daily basis. Unfortunately, a sudden neck issue flared up and she had to stop practicing. Admirably, Dr. Berdan decided that the next step in her career would be to volunteer in order to use her knowledge and expertise to help train the next generation of oral health professionals. She started volunteering at the Herman Ostrow School of Dentistry of USC once a week, supervising students performing real and simulated endodontic procedures. Dr. Berdan found this experience to be truly fulfilling and enjoyable, and once a week quickly expanded to multiple days a week.

Eventually Dr. Berdan began teaching as a part-time faculty member in the endodontics department. She became the endodontic course director and a

beloved presence on all floors of the dental school. In addition to using her skills and experience to educate and guide her students, Dr. Berdan's path to her current position sets an example of the importance of overcoming adversity and not giving up when facing seemingly insurmountable obstacles. Even when an unexpected and undoubtedly frustrating ailment threatened her career and future, Dr. Berdan found a way to turn a curse into a blessing and channel her skills and talent into shaping the next generation of dentists.

Dr. Berdan is no stranger to the importance of research. As a participant in multiple residencies, she has been part of research projects encompassing several areas of dentistry. During her time in pedodontic and endodontic residencies, Dr. Berdan realized the necessity of doing research for several reasons. "It's not just the content of the project itself," says Dr. Berdan, "it's the realization of how much there is to know, and the sheer amount of detail-orientation and involvement necessary in any clinical project." While understanding the importance of lab projects, Dr. Berdan has always had an affinity for clinical research projects, feeling that their results have more immediate and impactful effects on patient care. She has been involved with several such clinical ventures over her career, and has a great understanding of the benefits and shortcomings of these undertakings.

One of the biggest challenges in clinical trials in dentistry is their reliance on patient compliance and follow-through with recall appointments. Since the accuracy of this kind of research strongly depends on patient follow-ups, supplemental methods of data collection must sometimes be used to ensure the project reaches a conclusive and accurate result. One such method is a retrospective study design. Since the research subjects in this methodology have already finished treatment, the patient compliance variable is taken out of the equation. The biggest obstacle to this type of project is obtaining Health Insurance Portability and Accountability Act (HIPAA) permission to use patient charts and explaining to the Institutional Review Board (IRB) how the benefits of the project outweigh privacy concerns of using patient information. Dr. Berdan

is in the process of obtaining IRB and HIPAA approvals for one such project.

Utilizing her expertise and connections in the fields of pedodontics and endodontics, Dr. Berdan is currently leading a retrospective study comparing the efficacy of vital pulp therapy versus extraction and orthodontic treatment. Specifically, the study will look at the permanent first molars of children with pulpal involvement. The goal is to analyze the longevity of such teeth when treated with a pulpotomy or pulpectomy. Then, first molars that received alternative treatment will be studied. One such alternative treatment is the extraction of the first molar and the use of orthodontic therapy to pull the second molar mesially, effectively replacing the first molar with the second. The study will look at the longevity of each treatment, from time of treatment to 18 years old, in order to determine which method has the highest rate of success. While the study will initially focus on USC patients, Dr. Berdan's goal is for a multi-center study as this will give more comprehensive results.

There's no denying that Dr. Berdan has a hectic schedule. From her commitments in the endo and pedo clinics at USC, to her role as endo course director and the time she spends on the clinic floor, sim lab and lecture hall in that capacity, to her current pursuit of an MBA, Dr. Berdan's daily workload puts any student's schedule to shame. So how does she manage? According to Dr. Berdan, the key is to always be in the present. "When I'm at lunch with friends," she says with a chuckle, "I'm never thinking about the patient I have to see this afternoon or the lecture I have to give tomorrow." She also stresses the importance of focusing on one thing at a time and switching to a different topic once you notice your focus is slipping. Finally, Dr. Berdan has some advice for finding your calling in dentistry. "Shadow as much as you can and expose yourself to as many fields as possible," she says, adding that the endo clinic is always available for those who want to shadow. She also recommends reading research journals to find out what piques your interest. "This way, you can find the problem in dentistry that you want to be a part of solving."

From Lifeguard to General Practice Residency Professor

Abraham Zilberstein

Dr. Mark Mehrali has been an educator and an Assistant Clinical Professor of Dentistry at the Los Angeles County-USC Medical Center for the past twenty-four years. He has also been employed by the Los Angeles County Fire Department as a recurrent ocean lifeguard for the past thirty-nine years. He is currently working at Zuma, Malibu, and Point Dume beaches when he serves the county in this capacity. Dr. Mehrali usually works three to four weeks a year as a lifeguard. He is excited about an upcoming anniversary: he will have served the public of Los Angeles County for a total of sixty-five years in 2021, when he will have been a lifeguard for forty years and a doctor at the LAC-USC Medical Center for twenty-five years.

Dr. Mehrali grew up in Glendale as the oldest of three siblings with his two younger sisters. He is a first-generation American, as his parents immigrated from Iran and England and met at USC as students. After high school, Dr. Mehrali attended Los Angeles Valley College (LAVC), where he participated in both the water polo and swim teams with success. His coach, Bill Krauss, was his first “professional mentor” as Mr. Krauss was also the head of the Biology Department at LAVC. Mr. Krauss gave the future Dr. Mehrali the opportunity to be a tutor in the LAVC Biology Lab while he was moving forward through college. Mr. Krauss also was a legendary lifeguard and encouraged Dr. Mehrali to try out for the position. As such, Dr. Mehrali credits Mr. Krauss for everything he loves to do, especially being an ocean lifeguard at the beautiful beaches of L.A. County, and credits Mr. Krauss’s encouragement of his goal of becoming a dentist. After attending LAVC, Dr. Mehrali transferred to the University of California, Santa Barbara and earned bachelor’s degrees in both chemistry and economics. Dr. Mehrali continued his education in dentistry at the University of California, San Francisco, and upon graduation, he completed a general practice residency at the University of Illinois at Chicago. Upon moving back to California and being an associate for a couple of years, he purchased a practice in Camarillo where he has been practicing for the past twenty-four years.

Dr. Mehrali mentioned his family upbringing, which instilled in him the notion that mentoring people and

having a positive effect on others is how one leaves a mark on this world. Dr. Mehrali’s passion stems from his yearning to constantly learn, initially from his mentors, and now from his residents as well, thus synergistically impacting the future generations of dentists. Dr. Mehrali firmly believes that being a dentist requires continual learning through one’s career.

Dr. Mehrali related a story about a memorable patient whom he treated at the LAC-USC Medical Center for treatment. This patient, Mel, was a survivor of throat and lung cancer. However, in his battle with cancer, he was edentulated. Fortunately, he was able to have two implants placed in the anterior mandible and had upper and lower prostheses with which he could function. Prior to Dr. Mehrali running the New York Marathon one year, Mel mentioned that the LA Marathon runners run by his living space every year and he always wanted to do one. Dr. Mehrali bought shoes for Mel and they started training. This was incredibly inspiring as Mel was not only a cancer survivor, he also was diabetic and had to breathe through a tracheostomal tube. Dr. Mehrali and Mel not only finished their first LA Marathon together, they went on to run it three years in a row. Every hour they had to stop to check Mel’s blood sugar. Dr. Mehrali’s friendship with Mel was a victory for both, as Mel would come to the dental clinic at the LAC-USC Medical Center, put his finger on his tracheostomal tube, and murmur the words “If I can do it, you can do it.” The hardest part of the marathons for Dr. Mehrali was buying Mel a pair of running shoes, as his feet were size 13 EE! Mel’s feet were long and like skis. He needed a great pair of shoes to minimize his exposure to blisters. Mel completed three LA marathons at 82, 83, and 84 years old. He passed away a few years ago quietly on his couch.



Dr. Mehrali has engaged in different research projects with the GPR residents at the LAC-USC Medical Center. One of the more notable projects is studying the dental implant success rate on patients who have undergone jaw resections due to ameloblastoma. Although this research is in its preliminary stages, he has seen many patients dentally rehabilitated so that they can chew and smile again after their ameloblastoma was resected and subsequently reconstructed with bone grafts, dental implants, and then a dental prosthesis to restore function. The success rates of this treatment appears to be similar to traditional dental implant treatment modalities. As such, the data will be compiled and a statistical analysis completed to verify the outcomes that have been seen clinically at the LAC-USC Medical Center.

Dr. Mehrali recommends that dental students should utilize their time in dental school learning from the great educators and mentors who are available to them. It is important to be exposed to as many cases as possible so that one can graduate from dental school feeling confident in the skills necessary to provide dental treatments to our patients. Dr. Mehrali was elected into the Fellow of the American College of Dentists in 2014. He was humbled by the gesture bestowed upon him and vows to continue to treat patients with complex dental problems. Furthermore, as a mentor, teacher, and optimist, Dr. Mehrali feels that by teaching the residents in the GPR program at the LAC-USC Medical Center, our profession, our students, and our underserved patients will continue to be served in a positive way. Dr. Mehrali lives in Camarillo with his family and enjoys the Ventura County lifestyle in his spare time.



In closing, speaking with Dr. Mehrali, I could sense the reason why he was nominated for the Residency Spotlight. Dr. Mehrali has an organic personality with his ability to impact patients both within their personal lives as well as in a dental environment. It was truly an honor for me to speak with someone who has a sincere passion for their field and desires not only to help people with their smiles, but also for their well-being.



Looking Deeper into Obstructive Sleep Apnea

Ana Zapata Caceres and Alex Daneshgar

Dr. Allen Huang is currently a 5th year Oral and Maxillofacial Surgery (OMFS) Resident at the University of Southern California. He was born in Taiwan and grew up in Southern California, attending UC San Diego as an undergraduate majoring in general biology before attending UC San Francisco for his dental education. It was in dental school where he discovered his passion for surgery and the way he could change lives, which prompted him to apply for residency in OMFS. Dr. Huang was then accepted to the 72-month MD/certificate course that is offered in conjunction with the Keck School of Medicine of USC. In addition to the oral and maxillofacial surgery training, the program leads to a medical degree, which Dr. Huang obtained in 2018.

As a dental student, Dr. Huang realized the importance of mentorship and networking early on. With the help of his classmate (Brian Lee, DDS, MD) and mentor (Stanley Liu, DDS, MD), he created a platform known as Passing The Scalpel, an educational and networking initiative to bring together students, residents, and faculty in order to grow and develop the field of oral and maxillofacial surgery. Through live cadaveric operations, plating workshops, implant demonstrations, and bringing in world-renowned speakers, the goal was to inspire the next generation of oral surgeons. Now in its 10th year, Dr. Huang is proud to see that the initiative has grown and expanded to numerous dental schools and hopes that it will continue to do so from a national and international standpoint.

Beyond clinical duties and mentorship to dental students, Dr. Huang remains active in research as well. His research experience began as an undergraduate student when he studied heart regenerative cardiomyocytes. As a dental student,

he was involved in multiple research projects that ranged from educational reform to management of odontogenic keratocysts. Now as a resident, his primary research focus involves craniofacial anomalies and treatment of obstructive sleep apnea in infants. His current project evaluates the efficacy of mandibular distraction osteogenesis in treating obstructive sleep apnea in infants born with micrognathia and determining the length of distraction needed in order to prevent skeletal relapse as growth continues.

Outside the hospital walls, Dr. Huang also remains active in giving back to his community. Philanthropy has always played a significant role in keeping him grounded amidst his busy schedule. As an undergraduate, he began volunteering at homeless clinics, servicing the underserved populations as an x-ray technician and chair-side assistant. Years later, he continues to give back with his own mobile clinic that he started with pre-dental students from the University of California - Irvine. Their collective efforts were recognized by Ellen DeGeneres, for which the famous TV host donated \$35,000.

Dr. Huang's research and clinical training have sparked his interest in restoring form and function in patients with obstructive sleep apnea. He is currently applying to a sleep surgery fellowship with the hopes of extending his surgical practice to the full scope of airway reconstruction, which includes operating on the nasal passages, tonsils and palate, to maxillomandibular surgery. His plans are to stay in academia and continue to mentor future oral and maxillofacial surgeons. Dr. Huang is a hardworking and generous provider who embraces all the trojan values. We wish him the very best in his future endeavors. Fight on!

A case on Oral Pathology: How Viperin Proteins induce KSHV Helicase expression through Methionine-401 Oxidation

George Simonyan and Sarina Taylor

Dr. Youliang Rao is a Post- Doctoral Research Associate in the Department of Periodontology at the Herman Ostrow School of Dentistry of USC. He has been deeply invested in research for many years, since his involvement during his undergraduate career where he earned his bachelor's degree in Agronomy at the College of Animal Science and Technology at Northwestern A&F University. Dr. Rao continued his education at Hubei, China, where he earned his PhD in Agronomy at Huazhong Agricultural University. His research focus at that time revolved around insights into antiviral immunity against grass carp reovirus (GCRV) in grass carp fish species. In 2019, Dr. Rao moved to the United States to pursue further education at USC and to work alongside Dr. Casey Chen, who is the Section Chair of Periodontology at the Herman Ostrow School of Dentistry.

As dental clinicians, we are often the first health care professionals in line to examine and analyze a patient's oral anatomy and soft tissue health. Extra-oral and intra-oral examinations can be vital for detecting possible symptoms

and diseases present in our oral cavity. The wide array of findings and lesions that can be present in the oral cavity is often overlooked, and a thorough examination can detect early findings that can promote better prognoses. Within the population of vulnerable patients, especially those with uncontrolled medical problems and those who are immunocompromised, the oral cavity is usually the first location where symptoms and lesions can manifest.

HIV-positive patients present with compromised systemic immune conditions; this population is especially susceptible to secondary diseases that can be influenced by immune dysfunction. Oral lesions are common in HIV-infected individuals and may even be the

first sign of AIDS. Some of these oral lesions include fungal and viral infections such as candidiasis, deep fungal infections, herpes simplex virus infections, cytomegalovirus, hairy leukoplakia, and others. One particular virus, herpesvirus 8 (HHV-8), also known as Kaposi's sarcoma-associated herpesvirus (KSHV), is usually found in the latter years of HIV progression and is considered an AIDS-defining condition. AIDS-defining conditions and lesions are opportunistic infections and cancers that confirm the diagnosis of AIDS and can often be life-threatening in a person with HIV. It is important to understand how some diseases manifest and the biological processes underlying their proliferation. As dental clinicians, this information is in-

valuable, and building upon this knowledge will not only expand our competency, but also promote excellent health care for our patients. Understanding new research breakthroughs, such as Dr. Rao's work and others, will help us keep up to date with disease processes and how they relate to our clinical work.

Much of Dr. Rao's current work concerns the interaction between helicase expression and function, and the host innate immune responses during infection and pathogenesis. One component of Dr. Rao's research focuses on Kaposi's sarcoma-associated herpesvirus (KSHV). In Dr. Rao's research, he has revealed that KSHV helicase is closely related to human helicase MCM7. Helicases mediate a wide range of cellular processes involving nucleic acids such as replication, repair, recombination, transcription and translation. Dr. Rao and his team used immunoprecipitation coupled with mass spectrometry to analyze proteins that interact with these helicases. They found 58 proteins that interact with KSHV helicase and human helicase MCM7, and ranking first amongst the 58 was Viperin protein.

In order to explore the importance of Viperin protein in modulating KSHV helicase stability, they examined KSHV helicase expression in KSHV-infected cell lines after Viperin depletion. The research team engineered 11 mutants of KSHV helicase through single point mutations and left one mutant still containing methionine-401. When Viperin expression was depleted, the expression of

KSHV helicase containing methionine-401 decreased. However, Viperin deletion had little effect on the expression of those helicase mutants containing different single point mutants. These results demonstrated that methionine-401 site has the most effect on KSHV helicase stability through action of Viperin. In addition, they investigated whether this effect translates into the replication of KSHV genomic DNA. By detecting extracellular and intracellular viral genome copy numbers upon KSHV lytic induction, they found that the viral genome copy number declined in KSHV with helicase containing methionine-401 mutation compared with that which kept the Methionine-401 position stable. These results collectively showed that methionine oxidation by Viperin protein promotes helicase stability and replication of viral genomic DNA during KSHV lytic replication.

In recent years, it has become evident that Post-Translational Modifications (PTMs) have a profound effect on the localization, function and stability of helicases. However, research on PTMs of helicases thus far has been largely limited to focusing on three types of PTMs, including phosphorylation, ubiquitination and SUMOylation. This research study by Dr. Rao confirmed a previously unexplored PTM, methionine oxidation, which increases the stability and protein expression of helicases to promote their functions. Mechanically, Viperin catalyzes methionine oxidation of DNA and RNA helicases of human and virus origin, which is crucial for DNA replication and immune activation. Viper-

in promotes rather than inhibits HCMV infection and KSHV genomic DNA replication.

With his immense knowledge in the fields of virology and innate immunity, Dr. Rao plans on expanding his research to focus on interactions between oral pathology and innate immunity to further investigate oral diseases. In addition, Dr. Rao is also studying how infection with herpes viruses plays a role in other oral infections and tumorigenesis. Ultimately, he hopes that by utilizing our understanding of how the host immune system responds to oral infections and the evasion strategies from the pathogens, therapeutic interventions can be discovered and engineered to treat and prevent oral diseases.

Keeping Teeth Plaque Free Since 73

Brian Song

Professor Diane Melrose is the Chair of the Dental Hygiene program at USC and has mentored students here since 1976. Since receiving her dental hygiene degree from the University of Iowa in 1973 Professor Melrose has dedicated her life to improving oral health. She has worked extensively with special needs patients at the John F. Kennedy Institute and provided oral hygiene care to patients at Ranchos Los Miragas hospital. Since coming to USC, she has been an integral part of the hygiene program, teaching generations of students to be leaders in providing oral health to the community.

As Chair of the Dental Hygiene department, she has pushed for integration between dental hygienists and dental students, helping to expose both sides of the school to each other's unique perspectives. According to Professor Melrose, this "[emphasizes] our dental hygiene program's level of expertise and the advantage we have with it being housed within the dental school." This integration would involve dental hygiene students working side by side with dental students, taking courses and seminars together. Recently Professor Melrose also led the change to smaller hygiene classes to "[offer a] more personalized education and more one-on-one time between students and faculty."

Professor Melrose was the first hygienist in her family, and she recalls her inspiration for hygiene coming from her father, who received dentures at 28 years old. Seeing him come home and having to deal with the extreme discomfort from his dentures inspired her to help others avoid experiencing her father's pain. This experience, coupled with her seeing the effects of poor oral

hygiene on other family members, propelled her to pursue dental hygiene. This was only reinforced after she shadowed a dental hygienist and saw the amazing work that could be done. One of Professor Melrose's early memories as a child was examining her sister's mouth checking for oral hygiene, a true sign of her future successful career.

While at USC Professor Melrose has not only been a keystone member of the hygiene program, she has been an innovator for her field. Her current research is a project called "Evaluating the Development of Musculoskeletal Injuries in Dental Hygienists" which aims to find a novel method for early detection of median nerve pathology. Her study involves following dental hygiene students over a two-year period and evaluating their tissue morphology utilizing sonographic imaging, evaluating neurophysiologic changes using nerve conduction testing and monitoring subjective reports of symptoms. Her goal is to find dangerous habits of hygienists that lead to career-harming injuries, and then to provide solid strategies for mitigating these injuries.

For inspiring dental hygienists, Professor Melrose advises "to believe in yourself and believe you can do whatever you put your mind to" and to make sure "you truly care about others and have a clear passion in wanting to improve their quality of life." To current hygienists and all health care professionals, her advice is to have good communication with your patients and always have a positive attitude. Professor Melrose epitomizes this philosophy with her dedicated, passionate work in dental hygiene and strong commitment to the Herman Ostrow School of Dentistry of USC.

From her work with special needs patients at the University of Iowa and the John F. Kennedy Institute, to her breakthrough research on preventing musculoskeletal injuries in dental hygienists, Professor Melrose has shown her incredible passion for dental hygiene.



Transformative Care: Craniofacial Orthodontics

Scott Barlow &
Shveta Duggal

Dr. Vincent (Xuanyu) Lu realized his interest in dentistry at an early age and was a very curious child. To him, the most important thing has always been to find answers. When asked why research is so important to him, he said, "it is the idea that drove me to question facts, and research was the key to answering those ideas." Dr. Lu was born and raised in China, where he completed his undergraduate and graduate dental degrees. His interest in research and mentors at his dental

school motivated him to pursue a career in the United States. Subsequently, he completed his PhD in oral sciences followed by an orthodontic residency at the University of Illinois, Chicago. To advance his orthodontic skills, he went on to pursue a one-year craniofacial fellowship at Children's Hospital Los Angeles (CHLA). He is a board-

certified orthodontist and a part-time associate professor in the Division of Orthodontics at the Herman Ostrow School of Dentistry of USC. He also practices at CHLA as a craniofacial orthodontist.

Dr. Lu's research has been focused on bone regeneration since his PhD days. While he studied the function of amelogenin in enamel, periodontium and long bone he wondered how he could apply this research clinically to help patients. With this mindset, he went on to pursue his orthodontic residency at the University of Illinois, Chicago. There, he conducted a bone regeneration project in which he applied tissue engineering methods to enhance bone regeneration in anorganic bone grafts. This research project, titled "Characterization of a Biomimetically enhanced Bio-Oss for Bone Regeneration Applications," received the 2017 Research Aid Award (RAA) from the American Association of Orthodontists Foundation (AAOF).

During his fellowship training at CHLA, Dr. Lu worked closely with plastic surgeons, oral surgeons and pediatric dentists on an interdisciplinary craniofacial team. He received extensive training in treating craniofacial anomalies in children. Treating children with cleft lip and palate, hemifacial microsomia, craniosynostosis and other rare diseases and birth defects allowed him to master various techniques. At CHLA he studied and applied bone regeneration in cleft lip and palate patients. This experience allowed him to understand various factors affecting bone regeneration in these cases. Some of the most important factors affecting success are the position of the teeth and in particular the canines, the size of the cleft and the type of bone graft used. All these factors directly or indirectly influence bone regeneration outcomes. Dr. Lu used a new bone inorganic material called Bio-Oss® in human cleft lip and palate patients after pre-clinical studies showed promise in rats. He notes, "in most cleft lip and palate patients there is a bone defect and the bone grafting is done in two stages: primary bone grafting as early as 6 years old, and secondary bone grafting when the child is up to 9 years old. The primary bone graft is the initial lip repair during the neonatal/natal stage and the secondary bone graft is before the canine eruption. Most craniofacial teams avoid primary bone grafting as

it inhibits maxillary growth. So, most specialists opt for secondary bone grafting." Dr. Lu emphasizes that it is important for any dentist to be aware of which stage a cleft lip and palate patient is in, because the age of the patient and the timing of procedures will influence the bone regeneration outcomes.

When asked what challenges he faces as a craniofacial orthodontist, Dr. Lu smiled and said, "that to execute any treatment successfully, good team support and communication are important. Rather than focusing on one problem, as a team, we should be more focused on the long-term planning of that existing problem." He emphasized that it is the clinician's responsibility to provide emotional support to patients with craniofacial anomalies. He says that most of the patients and parents are frustrated and have psychological issues during treatment. The reason for this, Dr. Lu believes, is because of the knowledge barriers that exist. Dentists treating these types of cases have knowledge that they should share with patients and their families, but must also recognize the need to refer such patients to a specialist to achieve the best possible outcomes when it is outside their scope of practice.

Dr. Lu has published many peer-review articles and presented papers at many scientific meetings. His passion for leadership and research has won him a Research Aid Award from the AAOF and an Academic Leadership for Residents Fellowship award. He considers himself lucky to have had the amazing support of mentors who guided him all throughout his life. He feels fortunate to be a part of the distinguished orthodontic faculty at USC and would like to contribute in similar ways to the field of orthodontics. Dr. Lu is not only an excellent clinician and researcher, but he is a marathon runner as well. He has completed eleven marathons and is looking forward to the next one in Los Angeles.

On a concluding note, when asked what is the best compliment he has received as a craniofacial orthodontist, he said that he was proud to be able to treat children from his own country, China, at CHLA. Parents not only thank him for his expertise but also make future referrals for which he is also thankful.

Schedule of Events

Herman Ostrow School of Dentistry of **USC**

2020 Annual Research Day
April 8, 2020
USC Galen Center

08:00 am – Registration (Presenters and Judges)
09:00 am – 12:00 pm Poster Presentations Judging
11:30 am – 12:00 pm General Registration
11:30 am – 12:30 pm Lunch

12:30 pm – 12:45 pm Opening Remarks Maja Mataric, Interim Vice President of Research
Avishai Sadan, Dean
Yang Chai, Associate Dean of Research

12:45 pm – 01:25 pm Keynote Speaker Steve A. Kay
Provost Professor of Neurology,
Biomedical Engineering and Biological Sciences
Director of Convergent Bioscience
Director, MESH Academy
University of Southern California

01:30 pm – 02:10 pm Keynote Speaker Mariela Padilla
Associate Professor of Clinical Dentistry
Assistant Director of Distance Education Programs
Division of Periodontology, Dental Hygiene and
Diagnostic Sciences.
University of Southern California

02:15 pm – 02:55 pm Keynote Speaker James Finley
Assistant Professor of Biokinesiology and
Biomedical Engineering
Division of Biokinesiology and Physical Therapy
University of Southern California

03:00 pm – 04:30 pm Poster Viewing
04:30 pm – 05:00 pm Award Presentations
05:00 pm – 06:00 pm Reception
03:30 pm – 06:00 pm Career Fair (Hall of Fame, South)

Keynote Speakers

Steve Kay

Dr. Kay currently serves as the Director of the University of Southern California (USC) MESH (Medicine, Engineering, Sciences, and Humanities) Academy, the Director of the USC Michelson Center for Convergent Bioscience, and is a Provost Professor of Neurology, Biomedical Engineering and Biological Sciences at the Keck School of Medicine of USC. He held the position as the 21st dean of the USC Dornsife College of Letters, Arts and Sciences from 2012 to 2015.

Dr. Kay is one of the world's top experts on the genetics and genomics of circadian rhythms. Having published more than 200 papers, he was named by Thomson Reuters as one of "The World's Most Influential Scientific Minds" consecutively from 2014 to 2019 and has been cited in Science magazine's "Breakthroughs of the Year" three times since 1997. In 2008, Dr. Kay was elected as a member of the National Academy of Sciences of the USA. In 2009, he was elected as a fellow of the American Association for the Advancement of Science, and in 2011 he was awarded the American Society of Plant Biologists' 2011 Martin Gibbs Medal for his pioneering research on biological clocks in both plants and animals. In 2019, Dr. Kay was elected a Fellow of the Royal Society of London in recognition of his contributions to science. In 2020, Dr. Kay was appointed as University Professor at the University of Southern California in recognition of his outstanding scholarship in the field of genetics and genomics of circadian rhythms.



Mariela Padilla

Dr. Padilla is the Assistant Director of Online Distance Education Programs and Associate Professor of Clinical Dentistry in the Division Periodontology, Diagnostic Sciences and Dental Hygiene at Herman Ostrow School of Dentistry of USC. She is also the Director of the online Certificate in Orofacial Pain. In addition to her DDS (from University of Costa Rica), she completed an Advanced Residency Program in Orofacial Pain at UCLA, a Master in Education and Curriculum Design in Latin University, and is a Fellow from the Center for Excellence in Teaching of USC. She has combined her clinical practice with academics since 1990, as clinical provider, faculty, pedagogical adviser, and educational administrator. Her current work focuses in Educational Experiences Design related with Diagnostic Sciences in Dentistry, and is dedicated to create online academic programs and learning resources.

James Finley

Dr. James Finley is an Assistant Professor in the Division of Biokinesiology and Physical Therapy at the University of Southern California. Dr. Finley received his bachelor's degree in Mechanical Engineering from Florida A&M University and his doctoral degree in Biomedical Engineering from Northwestern University. Following his doctoral training, Dr. Finley completed a postdoctoral fellowship in Neuroscience at Johns Hopkins University. Dr. Finley and his research team in the Locomotor Control Lab develop models and experiments based on principles of neuroscience, biomechanics, and exercise physiology to identify the factors that guide locomotor learning and rehabilitation. Dr. Finley is also one of the founding directors of the USC SensoriMotor Assessment and Rehabilitation Training Center (SMART-VR Center). The Center's mission is to harness innovative advances in virtual reality to improve motor and cognitive function across multiple clinical populations such as stroke, Alzheimer's, and Parkinson's disease.



POSTER

CATEGORY

AWARDS

Advanced Dentistry Special Program Residents

CBY/PIBBS Graduate Students

Post-Doctoral Fellows

Undergraduate and DDS Students – Basic Sciences

Undergraduate and DDS Students – Clinical Sciences

Biokinesiology and Physical Therapy PhD Candidates

Biokinesiology and Physical Therapy MS and PhD Students

Biokinesiology and Physical Therapy Post-Docs and Residents

Occupational Science and Occupational Therapy Doctoral Students

Dean's Research Award

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.

DENTSPLY SIRONA SCADA AWARD - Student Competition for Advancing Dental Research and its Application

Dentsply Sirona and the American Association for Dental Research (AADR) have joined forces to co-sponsor the Student Competition for Advancing Dental Research and its Application (SCADA), formerly known as the Student Clinicians of the American Dental Association. The SCADA program advances our collective commitment to empower the next generation of dental leaders. By showcasing students' research, and recognizing their passion for discovery and innovation, we will fuel the future of dental care.

SOUTHERN CALIFORNIA SECTION OF THE AADR DENTAL STUDENT RESEARCH AWARD

The AADR Student Research Day Award is awarded to the best presentation at the university research day competition. The award shall be determined by the university judging committee.

DR. ANSEL WATROUS FACULTY RESEARCH AWARD

Presented to the mentors of the DDS students Basis Sciences and Clinical Sciences first place awardees.

DENTISTRY DIVISION FACULTY

Poster #1

Title: Dental implant osseous integration guided by bifunctional peptide-film, in vivo

Authors: Malcolm L. Snead, Marta Monjom, Joana M. Ramis, Candan Tamerler, Yan Zhou, Hans Jacob Rønold, Fernando Munoz-Guzon and S. Petter Lyngstadaas

Background: Implant osteointegration is dependent on surface bioactivity of titanium to induce Wnt-integrin signals, but implant bioactivity is significantly reduced by 6 months post-manufacturing. **Purpose:** A bifunctional peptide (TiBP-M59) consisting of a titanium binding peptide (TiBP) optimally linked by a spacer to a 59 amino acid amelogenin splicing variant (M59) to activate the Wnt osteogenic pathway was used to coat coin-shaped titanium implants via surface recognition in a randomized controlled experiment assessing osseointegration in the proximal tibia of twelve healthy adult female New Zealand White rabbits. **Methods:** After 6 and 8-weeks of healing the implant was recovered and assessed by: biomechanical testing using an implant pull-out test; gene expression of selected markers for bone formation (Runx2, osteocalcin, IGF-1) and resorption (TRAP, calcitonin receptor) of the peri-implant tissue; and by wound fluid markers (LDH, ALP activity and total protein). **Results:** Biomechanical evaluation of the implants showed a higher pull-out force for TiBP-M59-treated implants compared to control at both 6- and 8- weeks

healing. At both healing times, no significant differences were observed in the LDH or ALP activity measured from the wound fluid between groups. All gene markers for bone formation showed increased mRNA levels after 6 weeks of healing in peptide-treated compared to control implants, although no significant differences were found for bone-resorption gene markers compared to controls. **Conclusion:** Using a widely recognized animal model for implant surface activity, we identified increased osseointegration guided by the bifunctional peptide-film TiBP-M59 on titanium implants with no adverse impact on healing.

Poster #2

Title: Journey of a Virtual Patient System: A continuously evolving learning resource

Authors: Mariela Padilla, Luciano Nocera and Glenn T. Clark

Background: Challenging students with virtual patient scenarios have increasingly been used within health professional education to help them prepare for working with real patients. Especially considering that the student's education cannot entirely depend on the type of patients that walk in the door. **Purpose:** To discuss the journey of the Virtual Patient System from 1989 to date, to provide diagnostic skills in Orofacial Pain and Oral Medicine for undergrad and postgrad students at Herman Ostrow School of Dentistry. **Methods:** This is a descriptive report of five versions of the virtual patient system, comparing data on design, configuration, technical requirements, and student's performance. **Results:** The first version was produced in 1989 as a computer-based system, be-

coming web-based in 2003. An algorithm was created to provide alternatives for decision making, accordingly with data collected by selecting questions. In 2006, based on a USC Provost's grant a more sophisticated environment was developed, including an avatar for the student trainee and a simulated operator. The fourth generation (2010) was hosted in Unity 3D with a database for game data. In 2019 a more flexible and dynamic version was launched, with extend case types and domains, and support for mobile devices. **Conclusion:** Our VP creation journey has involved more and more sophisticated diagnostic simulation models where students learn to make correct decisions. Our system has continually evolved to respond to the training requirements, learning tendencies, and new technology developments of our time.

Poster #3

Title: Learner-centered Dental Admissions: 2. The Role of Calibration Sessions in the Multiple Mini-Interview

Authors: Anita Tourah, Robin Fox and Mahvash Navazesh

Background: The Multiple Mini-interview (MMI) was adopted as part of Ostrow dental school admissions to increase reliability and fairness in the admissions process. Having 2 evaluators for each interviewee is expected to decrease the possibility of bias; however it is of interest to assess concordance among interviewers to further refine the MMI tool. **Purpose:** To assess the degree of concordance among the pairs of interviewers of each applicant. **Methods:** Following interviewer calibration sessions, 4 pairs of 2 faculty/staff interviewers each evaluated

106 applicants for admission from January – April 2019 for the DDS Class of 2023. Using a scale of 1 ("Unsuitable") to 4 ("Outstanding"), 424 pairs of observations were generated. Correlation coefficients were derived via an Excel spreadsheet. **Results:** The correlation coefficient indicating the degree of concordance by two interviewers was $r=0.74$, which is an acceptable degree of positive association. For 26% of applicants, at least one interviewer indicated the candidate should not be admitted. In 12% of applicants, both interviewers agreed that that admission should not be offered. In the remainder of applicants (14%), there was substantive disagreement such that one interviewer indicated the applicant was "Unsuitable" or "Less Suitable" while the other interviewer indicated "Suitable" or "Outstanding". **Conclusion:** Calibration sessions help reliably assess candidates' performance on the MMI. Additional calibration may further increase concordance among interviewers.

Poster #4

Title: You've Come A Long Way, Baby

Authors: Joyce Galligan, Marlene Talley, Lisa Popkoff and Narine Daneilian

Background: The catchy slogan created by an ad agency in 1968 exemplified the Women's Lib movement in the country. Does the slogan apply to enrollment of women in US dental schools from 1968 to present day? How far have women actually come in terms of enrolling in dental schools? **Purpose:** To compare the enrollment increase of women at the Herman Ostrow School of Dentistry of USC (HOSD) with

the increase in the national average of women in dental schools nationwide. **Meth-ods:** Review and compare enrollment information from the ADA and HOSD. **Results:** The percentage of female students enrolled in a DDS/DMD degreed program in the United States has indeed come a long way. In 1968, 1.1% of dental students were female and at HOSD, the percentage of females enrolled was 0.98%. In 2018-2019, for the first time in history, female students made up for more than half of enrolled students for all four years in U.S. dental schools. According to the ADA Health Policy Institute, the statistics for gender were reported as 50.5% female, 49.2% male and 0.2% unknown. The HOSD is aligned with the current national average. Statistics show that for the most recent four years (2016-2019), enrolled students are 51.6% female and 48.4% male. **Conclusion:** Females are enrolling in U.S. dental schools in larger numbers than ever before and HOSD enrollment matches this trend. Women are becoming more integrated in the profession of dentistry. The profession should be equally open to everyone. We have come along way, baby!

Poster #5

Title: Lipophilicity of Peptide Amphiphile Nanofibers Optimizes Caveolae-mediated Wnt signaling

Authors: Yan Zhou, Erin Hsu, Samuel I. Stupp and Malcolm L. Snead

Background: Peptide amphiphile (PA) nanofiber designed to include bioactive domains that are instructional to cells undergo self-assembly in aqueous fluids into nanoscale filaments to mimic natural extracellular matrices. These PA molecules create supra-molecular nanofibers with a core-shell morphology built by collapsed hydrophobic segments and beta-sheets. Membrane-partitioning PA potentiates canonical Wnt signaling, which is initiated by the inter-

action of Wnt ligands with the Frizzled receptor and Lrp5/6 co-receptor. Phosphorylation of Lrp5/6 leads to cytosolic accumulation and nuclear translocation of beta-catenin to activate target gene expression. Lrp6 phosphorylation occurs in raft membrane domains with subsequent internalization into signaling-competent vesicles (caveolae) that are essential for Wnt pathway activation. Purpose: The requirement of caveolae was characterized in PA-mediated potentiation of canonical Wnt signaling. PA lipophilicity was tuned to optimize their membrane-partitioning phenomenon for maximal enhancement of Wnt signaling on bone marrow mesenchymal stem cell differentiation. The ability to modulate Wnt activated osteogenesis has significant potential for therapeutic application. **Methods:** The caveolin-mediated endocytosis was inhibited to block the formation of caveolae with two different approaches: 1) a metabolic inhibitor or; 2) siRNA specific for caveolin-1. Four PAs with different lipophilic tails were synthesized and their potential to enhance Wnt signaling was characterized. **Results:** PA-mediated potentiation of canonical Wnt signaling was abolished by the inhibition of caveolae formation. The four PAs with different lipophilic tails have distinctive effects on caveolae formation. **Conclusion:** Caveolae formation is required for the potentiation of canonical Wnt signaling by PA nanofibers. Lipophilicity determines the effect of PA-mediated signaling potentiation.

Poster #6

Title: Role of saliva in detecting the drugs of abuse

Authors: Azadeh Ahmadi and Mahvash Navazesh

Background: The drug overdose epidemic resulted in approximately 630,000 deaths from 1999 to 2016 according to the Center for Disease Control and Prevention (CDC). National Institute of Drug Abuse (NIDA) confirmed this data by reporting that drug-related deaths have more than dou-

bled since 2000. Purpose: Saliva has become increasingly area of focus for, detection, recognition and diagnosis of drugs of abuse. This is due to multiple factors such as simplicity, rapidity of collection, non-invasiveness and low bio-hazard considerations. Quite recently this matrix has been introduced in place of blood or urine testing. The purpose of the study is to review the validity of using saliva or oral fluid in comparison to urine. **Meth-ods:** "PubMed" database was searched using the key words; "saliva" AND "drugs of abuse" AND "urine". 136 publications between 2000-2020 were reviewed after initial search. 72 papers were included in the study and findings were summarized in the table. **Results:** Although most available studies confirm the validity of saliva to detect the majority of drugs of abuse; however, there are only few publications available in the literature that support the priority of using oral fluid to urine. **Conclusion:** According to the available studies in the literature with low to moderate level of evidence, saliva or oral fluid can be used in detection of drugs of abuse. Additional research with high level of evidence needs to be done in the future to determine the reliability of saliva in detection of drugs of abuse.

Poster #7

Title: Persistent Pain after Dental Trauma: A Case Report

Authors: Kenneth Leopold, Melvin A. Greenspan and Meir Keller

Background: Painful traumatic trigeminal neuropathy (PTTN) may result from a wide variety of trigeminal nerve injuries, ranging from mild to severe (Benoni et al, 2016). Approximately 3% of patients with trigeminal nerve injuries develop PTTN (Baad-Hansen, 2017). Purpose: To discuss the development of oral neuropathic pain and its treatment in a 40 y/o female after a dental trauma. **Methods:** Patient signed the authorization form that permits the use

of protected health information for education and instruction purposes. Medical history and clinical examination was performed by a trained practitioner in Orofacial Pain from the Herman Ostrow School of Dentistry. Findings are suggestive of non-odontogenic pain. **Results:** A 40-year-old female presented with a history of blunt trauma involving the anterior maxilla, which resulted in vertical fracture of tooth # 8 and unremitting pain. The tooth # 8 was extracted and a dental implant was placed. Teeth # 7 and # 9 were diagnosed with irreversible pulpitis and received endodontic therapy. The pain did not subside, and did not respond to analgesic therapy. A diagnosis of painful post-traumatic trigeminal neuropathy (PTTN) was considered and the patient was prescribed an anticonvulsant (Gabapentin 300mg up to 900mg/day). Symptoms improved and dental therapy was concluded. **Conclusion:** Persistent pain after an oral trauma may indicate the development of a neuropathic disorder. In cases with persistent pain, in absence of clear dental pathology, a PTTN should be considered.

Poster #8

Title: Local anesthetic injections for head and neck myofascial pain

Authors: Ehab Nouged, Jawdat Dajani, Bon Ku, Kamal Al-Eryani, Mariela Padilla and Reyes Enciso

Background: Myofascial Pain Syndrome (MFP) is a persistent musculoskeletal pain disorder. The presence of trigger points with referral pattern is characteristic of the condition. The use of local anesthetic injections to decrease pain and regain function has been described as one of the first-line treatments for MFP. **Purpose:** To evaluate the effectiveness of local anesthetic trigger point injections in adults with head and neck MFP, compared to dry needling, placebo, and other interventions. **Methods:** 15 Randomized controlled

trials using local anesthetic injections in 884 adults diagnosed with MFP were included. The primary outcome was pain (measured by VAS). Secondary outcomes included pain threshold, range of cervical motion, depression scale, and pressure pain intensity (PPI) score. The risk of bias was analyzed based on Cochrane's handbook. **Results:** Meta-analysis showed a significant improvement in VAS pain scale of 1.585 units at 1 to 4 weeks in the local anesthetic group compared to the dry needling group. However, when including only double-blinded studies, the effect was not statistically significant ($p=.020$). There was also a significant improvement in pain of 0.867 units with local anesthetic at 2 to 8 weeks compared with placebo ($p=.007$). No statistically significant differences were found in other secondary outcomes. **Conclusion:** Although local anesthetics injections provided significant improvement in pain, evidence on its effectiveness for the short-term treatment of head and neck MFP is of low quality, and sensitivity analyses provided no statistically significant difference.

Poster #9

Title: Community-based Oral Health Boot Camps for Interprofessional Education

Authors: Joyce Y. Sumi, Mariela Padilla, Anette Vistoso and Mina Habibian

Background: Healthy People 2020 identifies oral health as a leading health indicator yet most medical teams have not fully integrated dentistry into their disciplines. Academic program goals are challenged to meet interprofessional competencies and address health disparities. Limited research has investigated the impact of Boot Camp to improve interdisciplinary collaborative skills. **Purpose:** The purpose of this investigation was to pilot study the impact of a Community-Based Boot Camp model to improve interprofessional collaborative competencies.

Methods: The study used a convenience sample of graduate students in the Community Oral Health Program. They participated in daily workshop sessions focusing on six interprofessional core skills: Communication, Collaboration, Roles and Responsibilities, Collaborative Patient/Family-Centered Approach, Conflict Management and Team Functioning. These activities were followed up with observations and interactive discussions at seven community sites. The Interprofessional Collaborative Competencies Attainment Survey (ICCAS) was administered as a pre- and post-test instrument. Data from the ICCAS, an exit satisfaction survey and a final project were analyzed. The USC Institutional Review Board approved the study as exempt. The investigation was funded by an ADEA COS Grant and the USC Community Oral Health Distance Learning Program. **Results:** The quantitative data revealed slight improvement in 3 of the 6 interprofessional core skills. The qualitative data results from the exit survey and the presentation indicated that positive skills development had taken place. **Conclusion:** This project demonstrated a Community-based Boot Camp model for training interprofessional collaboration. The results showed this methodology can enhance personal and professional development through interprofessional education.

Poster #10

Title: Role of salivary biomarkers in cancer diagnostics

Authors: Sibel Dincer and Mahvash Navazesh

Background: Cancer is the second leading cause of death globally. Discovery of cancer specific biomarkers is critical for early diagnosis and monitoring of cancer prognosis. Utilization of salivary biomarkers in cancer diagnostics has received increasing attention in recent years due to non-invasiveness and cost effectiveness. **Purpose:** Clinical studies on human salivary biomarkers

of different types of cancers were reviewed and their potential role in cancer diagnostics were examined. **Methods:** Pubmed review of clinical research published between years of 2000 and 2018 on salivary biomarkers of cancer in humans in english language was conducted and is reported here. **Results:** Our review presents outcomes of 104 clinical studies. The most frequent studied salivary biomarkers are head and neck (34%), breast (19%), pancreatic (10%) and lung cancer (6%) biomarkers. Information on ovarian (4%), prostate (3%), brain (3%), hematological (3%), as well as hepatocellular (2%) cancer is limited but evolving Salivary biomarker panels: transcriptomic (mRNA, miRNA, lncRNA), metabolomic (nucleic acids, thiols, amino acids, endogenous metabolites), genomic / epigenomic (cfDNA, ctDNA, aberrant DNA methylation) and microbiomic (bacteria, viruses) are more frequently studied for their potential value in cancer diagnostics. **Conclusion:** Our review reveals abundance of information on salivary biomarkers and their use in monitoring the onset, progression and management of various cancers, reinforcing the potential value of salivary biomarker panels as future non-invasive diagnostic and screening tools.

Poster #11

Title: Comparison of Student Performance in MCQ vs. COMBOT Assessments

Authors: Nasrin Bahari Chopik, Sibel Dincer, Naren Ravindranath, Denise J. Tefft and Margarita Zeichner-David

Background: A summative multiple choice question assessment with images (computer based Test, COMBOT), or without images (multiple choice question, MCQ), are regularly developed and implemented at Herman Ostrow School of Dentistry (HOSD). These assessments are designed to measure retention, recollection and application of the knowledge students ac-

quire in their Problem Based Learning (PBL) courses. **Purpose:** Educational literature suggests that assessments with images result in improved student performance, in this study we wanted to compare the performance of our DDS students on both tests, using the same topics, and evaluate the reliability of these assessments to test students' application of knowledge. **Methods:** We used our assessment database to compare test scores for MCQ and COMBOT in trimester IV for the classes of 2019-2022. Statistical analysis was conducted using t-test: two sample equal variances. Reliability KR-20 (Kuder-Richardson Formula) value across MCQ and COMBOT tests were compared. **Results:** The two sample t-test statistical analysis showed $p\text{-value}<0.05$ when compared MCQ to COMBOT. An average Reliability KR-20 across 4 years (MCQ: $KR\text{-}20>0.85$; COMBOT: $KR\text{-}20>0.81$). **Conclusion:** Statistical analysis revealed that indeed, student performance increased significantly ($p<0.05$) when images accompanied the question (COMBOT). The high reliability measure, $KR\text{-}20>0.8$ indicates an internal constancy of the test scores and the reliability of the MCQ and COMBOT assessments. We interpret these test scores to reflect the efficacy of both MCQ and COMBOT assessments to measure student's ability to recall, analyze and apply acquired knowledge.

Poster #12

Title: KSHV hijacks CAD-mediated RelA deamidation to Promote Glycolysis and Cell Proliferation

Authors: Jun Zhao, Mao Tian, Ruoyun Gao, Alireza Delfarah, Nicholas A. Graham and Pinghui Feng

Kaposi's sarcoma-associated herpesvirus (KSHV) is the etiologic agent that causes Kaposi's Sarcoma (KS) and several lymphomas. Aerobic glycolysis, better known as "Warburg effect", preferen-

tially converts glucose into lactate even with sufficient oxygen supply, which is a hallmark of cancer cells and normal proliferating cells. KSHV was previously reported to reprogram glycolysis, yet the mechanisms are not well understood. We previously performed a focused screen and identified Carbamoyl-Phosphate Synthetase 2, Aspartate Transcarbamylase, and Dihydroorotase (CAD), as a bona fide deamidase of the NF-kappaB transcription factor RelA. Biochemical assays showed that CAD deamidated RelA in vitro and in cells. Remarkably, RelA deamidation abolished NF-kB activation, whereas potently promoted the expression of key glycolytic enzymes, thus fueling aerobic glycolysis and cell proliferation. A deamidation-resistant RelA mutant failed to promote glycolysis and impeded cell proliferation. In KSHV-latently infected human oral keratinocytes (HOK) and umbilical vein endothelial cells (HUVEC), RelA deamidation was induced in a CAD-dependent manner, resulting in the upregulated glycolysis. Our ongoing work is to delineate the detailed mechanism by which KSHV latent infection induces CAD-mediated RelA deamidation. Altogether, this work defines the first bona fide deamidase in metazoan, a novel function of CAD and RelA in metabolism and an unprecedented mode of transcription regulation via deamidation-mediated promoter selectivity, expanding the functional repertoire of protein deamidation. Meanwhile, findings garnered from our study will define a new viral mechanism underpinning KSHV oncogenesis and provide potential new means to treat KSHV-associated malignancies and diseases alike.

ADVANCED SPECIALTY PROGRAM RESIDENTS

Poster #13

Title: Decompression and Marsupialization in Endodontics: A Case Report

Authors: Rayan Alrehili, Sarah Barzanji, Ana Meneses and Henry Kwon

Faculty advisor: Rafael Roges

Introduction: Marsupialization is defined as a technique involving the creation of a large window of the cyst wall, converting the cyst into a pouch so the cyst is decompressed, exposing the cyst lining to the oral environment. This technique is rarely used in Endodontics, in this report we show a case of a cystic lesion related to teeth #9,10. **Methods:** A 29-year-old male patient reported to the Department of Endodontics, University of southern California, Los Angeles, with chief complaint of swelling in the upper front region of jaw. Patient gave history of trauma in upper anterior teeth, which had occurred more than 20 years back. A decompression and marsupialization were done and irrigated with Hank's balanced solution. Preparation was done and a 13 mm of a tube placed. Patient was instructed to irrigate with Saline every day for a month. Followed by apicoectomies #9,10. **Result:** After 1 year follow up, there is a significant amount of healing and the patient was asymptomatic. **Conclusion:** This case report presents that marsupialization is a technique sensitive but suitable as conservative treatment for large cystic lesions. However, it requires a cooperation between patient and dentist to insure success.

Poster #14

Title: Efficacy of Antidepressants in the Treatment of Obstructive Sleep Apnea

Authors: Magda R. Abdel-Fattah, Song W. Jung, Melvin A. Greenspan, Mariela Padilla and Reyes Enciso

Faculty advisor: Mariela Padilla and Reyes Enciso

Background: Currently, the gold standard to treat Obstructive Sleep Apnea (OSA) is CPAP, with Oral Appliance therapy as an alternative treatment. Medications have been

explored as a treatment option in that inhibiting serotonin's break-down or reuptake provides a tonic excitatory input to hypoglossal motor neurons innervating the genioglossus and other upper airway dilating muscles. Therefore, a mechanism may exist for such pharmaceuticals to treat OSA.

Purpose: To establish the efficacy of oral antidepressants compared to placebo in improving OSA as measured on a polysomnography study.

Methods: Randomized placebo-controlled studies were analyzed. Antidepressants included tricyclic antidepressants (TCA), tetracyclic antidepressants (TeCA), selective serotonin reuptake inhibitors (SSRI), and serotonin receptor modulators (SRM). **Results:** The initial search yielded 254 unduplicated references, reduced to 8 relevant studies, including 198 participants. Patients with an average baseline AHI of 26.7 events/hour taking 15-45mg mirtazapine had a statistically significant reduction in AHI compared to placebo by -10.5 events/hour ($p < 0.001$), apnea index by -3.6 events/hour ($p = 0.001$) and hypopnea index by -5.9 events/hour ($p = 0.037$). In one study, patients taking 100mg trazodone for 1 night improved significantly in AHI compared to placebo group ($p < 0.001$). Arousal index, sleepiness, and sleep efficiency were not significantly reduced with any antidepressant medication compared to placebo ($p > 0.05$).

Conclusions: Only mirtazapine and trazodone showed a statistically significant reduction in AHI; sleepiness scale and increase in sleep efficiency were not significant. Based on the evidence available at this time, we cannot recommend the antidepressants studied in the treatment of OSA.

Poster #15

Title: Treatment Management Periapical Lesion Associated with Silent Trauma on Anterior Teeth

Authors: Mohammad Tarrosh, Pouya Parsa, Rafael Roges and Steven Zwiag

Faculty advisor: Rafael Roges

A 51-year-old male presents with chief complaint of "pain on front tooth when biting". Patient denied any history of trauma. However, patient claims that he had history of surgery done 5 years ago, and after recovery he was informed that during endotracheal extubation the patient's front tooth was damaged. Based on clinical examination and radiographs of tooth # 9 the diagnosis is pulpal necrosis with symptomatic apical periodontitis. Initially, root canal treatment was done on September 2018. During the 1 year follow up, patient reported "one month ago my gum became swollen". Clinical examination revealed that there is a sinus tract, which was traced using Gutta Percha and it lead to tooth # 9. Cone beam computed tomography (CBCT) was obtained to evaluate the size of the lesion. The lesion's diameter was more than 9mm with buccal and slight palatal through and through cortical plate perforation. Ultimately, apicoectomy was performed on the tooth on October 2019, and biopsy was submitted to the lab. The result of the biopsy is pending at this time.

Poster #16

Title: Design and in vivo testing of novel bisphosphonate-fluoroquinolone conjugates chemisorbed to bone graft material

Authors: Raffie Garabedian, Esmat Sodagar, Junia Wadia, Shuting Sun, Philip Cherian, Jeffrey Neighbors, R. Graham G. Russell, Charles E. McKenna, Frank H. Ebetino, Nema Bakhshalian and Parish P. Sedghizadeh

Faculty advisor: Parish P. Sedghizadeh

In this study, we designed BP-ciprofloxacin and BP-moxifloxacin conjugates as a novel bone graft formulation and tested them as a combination product in an animal model to assess initial safety and bone grafting efficacy in vivo. Our study was designed as a ca-

nine (beagle dogs, n=3 based on power analysis) split-mouth surgical extraction and anorganic bovine bone-grafting model to test our conjugates against negative (collagen sham) and positive (bone graft without conjugate) controls. Quantitative 3D volumetric CT and histologic morphometric analyses were performed to examine the volume of de novo bone present in surgical defects as compared to residual graft material and fibrous tissue. No adverse events were identified in any study animals throughout the study period, and all sites when examined histologically revealed no evidence of necrosis, infection, osteolysis or foreign body reaction. Bone volume or regeneration in the surgical defects was greatest in the conjugate bone graft group as compared to the bone graft substitute without a conjugate group ($p < 0.001$, ANOVA) and also to the negative controls ($p < 0.001$, ANOVA). Our results indicate that BP-fluoroquinolone infused bone grafts did not adversely impact graft survival and de novo mineralization was superior to that of bone graft substitute alone, indicating that the antimicrobial and/or antiresorptive properties of conjugates improve bone remodelling and healing outcomes. BPs have previously been shown to increase the density of impacted graft bone, so our dual-action conjugates employing BPs bound to releasable antibiotics chemisorbed to bone graft material is a promising tool for applications to orthopaedic and dental bone grafting.

Poster #17

Title: Intra-articular Steroids for TMJ Pain: A Single Center Retrospective Study

Authors: Chitra Priya Emperumal, Mariela Padilla, Glenn Clark and Reyes Enciso

Faculty advisor: Mariela Padilla

Background: Avoidance, physical and pharmacologic therapy are the first line of treatment for Temporomandibular Disorders. In refractory patients, intra-articular steroid injections may serve as an option. **Purpose:** To determine the effectiveness of steroid injections in TMJ numerical rate pain verbal scale (NRS) reduction in patients at the USC Orofacial and Oral Medicine Center. **Methods:** A retrospective study was conducted to identify patients with various TMD painful disorders, who received an intra-articular steroid injection, from February 2015 through August 2019. The descriptive data was analyzed with Excel. IBM SPSS Statistics version 25 was used for normality test (Shapiro-Wilk) pre- and post-treatment NRS, and Wilcoxon matched-pair signed rank (2 samples). IRB# UP-07-00416. **Results:** A total of 41 charts were included (83% female and 34% over 60 years of age), representing 47 injections. In 57% of the cases arthralgia was first diagnosis, and osteoarthritis second (20%). The left TMJ was injected more often (59% of the cases). Pre- and post-treatment NRS was obtained in 37 cases. Both variables failed the normality test ($p > 0.05$). The median improvement in NRS was 4 units (mean=3.91, SD=3.17) with an average of 12.8 weeks before the follow up. The improvement was not significantly better with time (correlation score = -0.069; $p = 0.686$). 9 patients did not return for follow up. **Conclusion:** Intra-articular steroid injection is a suitable procedure to reduce pain in the TMJ, with only transient side effects reported in the studied population.

Poster #18

Title: Achieving Accuracy in Orofacial Pain Diagnosis with a Customized Diagnostic-System

Authors: Anette Vistoso, Luciano Nocera and Glenn Clark

Faculty advisor: Glenn Clark

Background: Estimates suggest that 12% of the population is affected by orofacial pain. These conditions are varied and are therefore challenging to diagnose and treat. The ADEA Competencies for a General Dentist, includes the diagnosis and management of OFP as a core competency. **Purpose:** Our study used a customized diagnostic system that is highly structured and therefore amendable to advanced data analysis (i.e. machine learning). **Methods:** Creating a Structured Data Set: Finding a set of diagnosis-specific high-frequency variables (HFVs) involved text mining of 450 first-visit narrative orofacial pain patient notes. Our text-mining discovered 137 logical clinical history and examination variables and 25 diagnoses, as assigned by our clinical experts. Mining the Structured Data Set: Data mining then identified a set of diagnosis-specific HFVs defined as being present $\geq 67\%$ of the time. Of these original 137 variables, only 53 were found as HFVs associated with our diagnoses. Predictive Algorithms: Next, 25 diagnostic predictive algorithms were created to score individual patient data for each diagnosis. A ROC curve analysis yielded cutpoints with the highest sensitivity and highest specificity. **Results:** Accuracy of the algorithms was examined using a new test data set of 50 additional first-visit narrative notes from Orofacial Pain patients. Only the five highest scores that were above our minimum cutpoints were used and compared to the actual diagnoses. An acceptable accuracy score (percent of time our predicted diagnoses and our actual diagnoses agreed). **Conclusion:** The predictive diagnostic algorithms used in this study demonstrated an acceptable initial accuracy hit ratio.

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Poster #19

Title: The Accuracy of Intraoral Scans of Interproximal Spaces with and without Saliva: A Prospective Clinical Study

Authors: Katie Schwartz Nasoff, Glenn Sameshima, Andre Weissheimer, Kevin Yin, Cory Nasoff, Hany Youssef and Kimberlin Low

Faculty advisor: Andre Weissheimer and Glenn Sameshima

Background: Digital workflow in orthodontic treatment planning relies on the accuracy of scanners to generate 3D models from patients' malocclusion. At the end of treatment, undiagnosed diastemas lead to unhygienic and unaesthetic spaces. **Purpose:** The purpose of this clinical study was to evaluate whether the presence of saliva affects the accuracy of interproximal spaces of digital models made from intraoral scans. **Methods:** The sample consisted of 15 individuals with 29 spaces. Subjects had at least one space in a dental arch. The spaces were measured intraorally. The arches were scanned with and without saliva using the 3Shape TRIOS3®. The 3D models were uploaded to Meshmixer™. Three measurers were asked to measure spaces on each model. Wilcoxon Signed Rank and Mann Whitney U tests were performed to determine whether saliva affected the spaces on the digital models. **Results:** Measurements of spaces on models with and without saliva were not significantly different ($P > 0.05$) from intraoral measurements of the same spaces. Spaces less than 0.3 mm were not accurately represented. Model measurements 0.4 mm and above were significantly different than the intraoral measurements. The absence of saliva did not lead to more accurate measurements. **Conclusion:** Regardless the presence of saliva, small spaces (< 0.3 mm) were not diagnosed on the scans while spaces 0.4 mm and above were recognized but not accurately measured. For small spaces, diagnosis remains a challenge in the orthodontic digital workflow when intra-oral scans obtained with the 3Shape TRIOS3® Intraoral Scanner are used.

Poster #20

Title: Effects of Respiratory Muscle Therapy on OSA: Systematic Review

Authors: Brien Hsu, Chitra Priya Emperumal, Mariela Padilla and Reyes Enciso

Faculty advisor: Reyes Enciso

Background: Alternative methods of management for obstructive sleep apnea (OSA) have long been sought by clinicians beyond the CPAP device, surgical interventions and/or mandibular advancement appliances. **Purpose:** To conduct a meta-analysis evaluating the effects of respiratory muscle therapy (i.e. oropharyngeal exercises, speech therapy, breathing exercises, wind musical instruments) compared to control therapy or no treatment in improving Apnea-Hypopnea Index [AHI], sleepiness and other polysomnographic outcomes for patients diagnosed with OSA. **Methods:** Randomized controlled trials searched using PubMed, EMBASE, Cochrane and Web of Science up to November 2018 were included and assessment of risk of bias was completed using the Cochrane handbook. **Results:** Nine studies with 394 adults and children diagnosed with mild to severe OSA were included, all assessed at high risk of bias. Eight out of the nine studies measured AHI and showed a weighted average overall AHI improvement of 39.5% vs baselines after respiratory muscle therapy. Based on our meta-analyses in adult studies, respiratory muscle therapy yielded an improvement in AHI of -7.6 events/hr ($p=0.001$), apnea index of -4.2 events/hr ($p=0.016$), Epworth Sleepiness Scale of -2.5 out of 24 ($p=0.066$), Pittsburgh Sleep Quality Index of -1.3 out of 21 ($p=0.026$), snoring frequency ($p=0.044$) in intervention groups compared to controls. **Conclusion:** This systematic review highlights respiratory muscle therapy as an adjunct management for OSA but further studies are needed, due to limitations including the nature and small number of studies, heterogeneity of interventions and high risk of bias with low quality of evidence.

Poster #21

Title: Bonding Accuracy of a Novel Lingual Customized

Appliance (INBRACE): In-Vivo Study

Authors: Zoey Gutierrez, Andrew Weissheimer and Kevin Yin

Faculty advisor: Glenn Sameshima

Background: It is important to know how accurate the indirect bonding procedure is for any orthodontic appliance used clinically. **Purpose:** The purpose of this study was to assess the accuracy of an indirect bonding technique for INBRACE system, a computer-aid designed customized appliance. **Methods:** The sample comprised of 12 individuals from the USC Orthodontics clinic who were undergoing orthodontic treatment with INBRACE appliance. Initial scans from each patient were used to virtually place brackets and fabricate custom CAD/CAM lingual appliances through INBRACE. The brackets were indirectly bonded to the patient following the protocol provided by INBRACE. Post-bonding scans (PBM) were obtained clinically and superimposed with The initial scans containing the virtual bracket models (VBM). **Results:** Bracket positions between the VBM and the PBM showed a statistically significant difference in bonding positions when comparing all the teeth in the sample ($P < 0.001$) with a Root Mean Square (RMS) mean error in bonding of 0.332mm. One-way ANOVA analysis showed statistically significant differences in the bracket positioning between the 6 segmented Indirect bonding (IDB) trays ($P < 0.0001$); lower posterior segments showing most bonding errors. Within each segment, the bonding errors did not differ significantly between teeth ($P > 0.05$). **Conclusion:** INBRACE had a good bonding accuracy (average error 0.33mm) which is clinically accurate and acceptable for a customized lingual appliance. The bonding accuracy was better for the anterior segments compared to the posterior segments. There was no difference in the bonding accuracy for individual teeth within each IDB tray.

Poster #22

Title: 3D Assessment of Virtual Bracket Removal for Modern Orthodontic Retainers

Authors: Kaitlin Marsh, Andre Weissheimer and Kevin Yin

Faculty advisor: Glenn Sameshima

Background: Computer-aided design and manufacturing of orthodontic retainers from digitally debonded models can be used to facilitate same-day delivery. **Purpose:** The purpose of this prospective clinical study was to evaluate the accuracy of virtual bracket removal (VBR) techniques using an in-house VBR protocol and two orthodontic laboratories to provide evidence-based support of clinical use of different VBR systems. **Methods:** The sample consisted of intra-oral scans of 20 patients. Four groups were compared. The scans without brackets were used as a control group. VBR was performed by three groups: In-house VBR software Meshmixer™, ODL Laboratories, and NeoLab. The virtually debonded models were superimposed onto the control models, and 3D Euclidean distances between surface points of superimposed models were calculated for comparative analysis of surface changes due to VBR. Surface changes were expressed via color mapping using VAM software. **Results:** The accuracy of VBR using the Meshmixer™ protocol did not differ significantly from VBR protocols done by the two labs. However, there was a statistically significant difference ($p < 0.05$) between the two labs, with ODL showing the least accuracy. There was also a statistically significant difference between the three tooth segments (incisors, canines/premolars, and first molars), with VBR of the first molars and second premolars showing the least accuracy. **Conclusions:** VBR using the in-house Meshmixer™ protocol is comparable to VBR using Neolab or ODL Laboratories. VBR accuracy increases from posterior teeth to anterior teeth. VBR using any of the three protocols is clinically acceptable

for computer-aided design and manufacturing of retainers.

Poster #23

Title: Trigger points for Myofascial Pain: A Retrospective Study

Authors: Erick Gomez, Yuka Abe, Mariela Padilla and Glenn Clark

Faculty advisor: Mariela Padilla

Background: Myofascial pain (MFP) has been reported in 85% of patients with temporomandibular disorders. The masseter muscle is often a source of referred pain. **Purpose:** The purpose of this study was to determine the most common location of a facial trigger point and the efficacy of anesthetic injection. **Methods:** Retrospective study conducted at the Orofacial Pain and Oral Medicine Center of USC. Data collected from June 2018 to October 2019. A single researcher reviewed the cases assigned to a single provider, to identify those with MFP, and created a de-identified database. Demographics, chief complaint, diagnosis, and numerical rating pain scale (NRS) before and after a trigger point were collected. The descriptive data was analyzed with Excel. IBM SPSS Statistics version 25 was used for normality test (Shapiro-Wilk) pre- and post-treatment NRS, and Wilcoxon matched-pair signed rank (2 samples). IRB# UP-07-00416 **Results:** Fifty-one patients were included in the analysis. All patients were given the USC myofascial protocol, and 11 (22%) of those received a trigger point injection, mostly in the masseter muscle. There was a significant decrease in the median NRS after treatment (pre-treatment 7 units vs. post-treatment 5 units; Wilcoxon matched-pair signed rank test $p < 0.001$). The median improvement in NRS was 3 units with an average of 7.8 weeks for the follow up. Improvement decreased significantly with time (correlation score = -0.298; $p = 0.034$). **Conclusion:** Patients who received the trigger point in-

jection as part of the therapy showed improvement in NRS.

Poster #24

Title: Alveolar Segmental "Sandwich" Osteotomy with Interpositional Allograft for Vertical Defects

Authors: Christopher Chan, Ara Mirzaian and Bach Le

Faculty advisor: Bach Le

Purpose: To report the outcomes of interpositional osteotomy with particulate allograft in the treatment of vertical defects in the anterior maxilla and mandible in preparation for implant placement. **Methods:** Vertical defects in the anterior maxilla and mandible (10 maxillary and 2 mandibular) in twelve consecutive patients were augmented. An interpositional osteotomy was performed to position the segment 5 mm coronally and fixated with titanium mini-plates and screws. The intergap space was filled with particulate allograft and covered with a resorbable collagen membrane. The amount of vertical bone augmentation was analyzed by cone beam computed tomography and stratified based on the number of missing teeth in each segment. **Results:** The mean vertical bone gain for interpositional osteotomy with particulate allograft was 3.7 mm (± 1.6) in the area of the greatest vertical defect. The length of the interpositional segment ranged from two, three, four, or five teeth edentulous sites. Mean vertical bone gain at the area of the greatest vertical defect for these segments were 1.7 mm (± 0.5), 3.8 mm (± 1.0), 4.6 mm (± 0.9), and 6.7 mm (± 0.0), respectively. Of the 20 implants placed, 2 failed (90% success rate) and were successfully replaced. There were no complications associated with graft failure, infection, or wound dehiscence. **Conclusion:** The interpositional osteotomy with particulate allograft is a predictable method for vertical augmentation in the anterior maxilla and mandible. Vertical height gain is directly proportional to the span

of the grafted segment, with five teeth segments achieving the greatest gain whereas two teeth segments were minimal.

Poster #25

Title: Mineralized Allograft with Tenting Screws for Augmentation of Edentulous Maxilla

Authors: Christopher Chan and Bach Le

Faculty advisor: Bach Le

Background: Bone augmentation in patients with the severely atrophic edentulous maxilla is challenging due to difficulty with temporization during the post-surgical healing period. Direct loading of grafted sites by complete denture wear can cause graft failure and/or significant resorption. **Purpose:** To evaluate the effectiveness of a mineralized allograft with tenting screws to resist the load of denture wear after augmentation of the atrophic maxilla. **Methods:** This study evaluated 12 consecutive edentulous patients with atrophic edentulous maxilla who underwent alveolar ridge augmentation using a mineralized allograft with tenting screws. All patients functioned on a complete denture immediately after the procedure. Visualization software was utilized to compare the bone change after grafting at 8 sites on the ridge. One independent examiner, who was not involved in the surgery, performed all analyses. **Results:** The average age of the patient was 61 years old, and the average period between pre and post-reconstruction CBCT was 14.9 months. The mean bone volume gained was 39.1%. At the 4 edentulous sites, the mean width gained 2 mm below the crest and at the midcrest was 2.25 mm and 4.12 mm, respectively. A total of 67 implants were placed with 6 failed implants that were successfully replaced. **Conclusion:** The use of mineralized allograft and tenting screws is effective in increasing alveolar width for implant placement in patients with the severely atrophic maxilla. Tenting screws help resist loading of the grafted sites to allow early function

on a complete denture and reduce graft failure or resorption.

Poster #26

Title: Controversies in Pediatric Mandibular Tumor Reconstruction

Authors: Christopher Chan, Jordan R. Wlodarczyk, Erik M. Wolfswinkel, Pedram Goel, Lauren T. Odone, Ravi Garg, Mark M. Urata, Lori Howell, Ibrahim Z. Khansa and Jeffrey A. Hammoudeh

Faculty advisor: Jeffrey Hammoudeh

Background: Although the reconstructive paradigm of the adult mandible has been well documented, guidelines for pediatric mandibular reconstruction (PMR) are more controversial. Free fibula and iliac crest reconstruction have been utilized with great success in adults, but limitations exist in the pediatric population as they are still growing, possess mixed dentition, and traditionally cannot have dental implants. **Purpose:** Propose an algorithm for PMR based on literature review and our experience. **Methods:** A systematic review of the current literature surrounding PMR was completed according to PRISMA guidelines. Retrospective chart review of patients who underwent PMR at Children's Hospital Los Angeles between 2005-2019 was also performed. **Results:** Thirteen patients underwent PMR for various pediatric mandibular tumors. Different reconstructive methods included both vascularized bone grafts (VBG) and non-VBG such as cadaveric tissue, corticocancellous iliac crest, rib, custom fabricated endoprosthesis, and custom crib. The mean mandibular defect size for VBG (n=10) and non-VBG (n=3) was 7.8 \pm 2.9 cm and 12.5 \pm 6.2 cm, respectively. Mean mandibular defect size for both groups was 8.9 \pm 4.1 cm. 54% of patients experienced complications, and 46.2% of patients underwent successful dental implant placement. **Conclusions:** PMR can be performed with

minimal morbidity, and dental implants can be placed with high success. Smaller mandibular defects may be restored with less invasive methods allowing for the preservation of VBGs for future reconstruction. Based on our experience, the traditional 6 cm limit on utilizing non-VBG should only be a guideline and may be expanded for different indications.

Poster #27

Title: Simultaneous LeFort III and LeFort I Osteotomies in Craniometaphyseal Dysplasia

Authors: Christopher Chan, Ravi Garg, Jordan Wlodarczyk, Stephen Yen and Mark Urata

Faculty advisor: Mark Urata

Background: Craniometaphyseal dysplasia (CMD) is a rare genetic disease affecting bone metabolism. Sclerotic hyperdense facial bones cause malocclusion, inhibit orthodontic movement, and reduce maxilla projection. Orthognathic surgery in this population is rarely reported due to possible complications arising from abnormal bone density. **Purpose:** Describe simultaneous LeFort III and LeFort I osteotomies in a CMD patient for treating facial deformity, malocclusion, and obstructive sleep apnea (OSA). **Methods:** We present the case of a 19-year-old male presenting to Children's Hospital Los Angeles with complaints of malocclusion, midface hypoplasia, and severe OSA with apnea-hypopnea index = 89. Computed tomography showed calcified maxillary sinuses and a dense craniofacial skeleton. **Results:** Multiple challenges were encountered during the surgery. The bicoronal approach to the LeFort III osteotomies required greater subperiosteal dissection due to unusually adherent periosteum to the calvarium. When performing osteotomies, surgical cutting saw tips had to be replaced frequently due to dulling from sclerotic bone. Traditional auditory feedback from osteotomes to indicate contact with the cranial base was also not reliable. In addition, the ossified maxillary sinuses

created uneven down fracture during the LeFort I separation. The maxilla was ultimately advanced a total of 8 mm; 7 mm and 1 mm at the LeFort III and LeFort I level, respectively. There were no postoperative complications, and the patient was satisfied with his improved midface projection and occlusion. **Conclusion:** With proper planning and consideration for dense bone morphology, simultaneous LeFort III and LeFort I osteotomies can safely be performed in CMD patients.

Poster #28

Title: Services delivered to underserved adults visited Ostrow Dental Clinics in Skid Row

Authors: Kamelia Ebrahimian Payvand, Mehdi Mohammadi, Reyes Enciso and Roseann Mulligan

Faculty advisor: Mehdi Mohammadi

Background: The rates of morbidity and mortality in homeless population are high compared with the general population due to poor living conditions. Moreover, there is no solid data on the oral health status of homeless population in the United States. Only few studies have described dental needs and use of dental services by homeless. **Purpose:** To describe most common dental services received by underserved adults in Ostrow dental clinics (URM & JWCH) located in Skid Row area. **Methods:** A retrospective chart review was performed on patients who were seen at URM and JWCH dental clinics in Skid Row, Los Angeles. Data were drawn from electronic dental records from 2010 through 2017 including, dental procedures, age groups, race, ethnicity and year of visit. **Results:** our findings show evidence of certain procedures such as dental fillings and extractions are higher than other procedures. **Conclusion:** Our study demonstrates a high were performed with $p < 0.05$ indicating statistical significance. Results: Findings from this study will reveal demographic and clinicopath-

need for preventive and restorative dental therapy needed for residents of Skid row.

Poster #29

Title: A 10-year institutional retrospective case-control study of oral lichen planus

Authors: Tarun Mundluru, Amirali Karimi, Masoumeh Hassan Pour, Kaveh Ghods, Conor Perrin, Erick Gomez, Anette Vistoso, Chitra Emperumal, Mohammad Khalifeh, Parish Sedghizadeh and Andrew Sanapaya

Faculty advisor: Parish Sedghizadeh

Purpose: To conduct a retrospective case-control study of oral lichen planus patients at a major university clinic in order to characterize and analyze the natural history of the disease, risk factors and comorbidities, and therapeutic responses. **Background:** Immune mediated diseases like lichen planus have complex etiopathogenesis. Oral involvement is common, treatment responses vary, and previous data implicates lichen planus may be associated with other chronic illnesses. **Methods:** This study constitutes a 10-year retrospective case-control study of oral lichen planus patients compared to age and sex-matched controls at the University of Southern California (USC). Institutional review board approval was obtained for this study. The Herman Ostrow School of Dentistry of USC electronic health record (AxiUm, ExanSoftware, Henry Schein Co., BC) was queried for patients of record from a 10-year period (2010-2020), and data was collected via Oracle database management software by an information technology data analyst. Demographic, clinicopathologic, and therapeutic parameters (independent variables) were assessed first by descriptive analyses with lichen planus as the dependent variable. To investigate differences between the lichen planus versus control group, Chi-square and independent samples t-tests

ologic associations, and statistically significant risk factors, for patients with lichen planus as compared to controls. **Conclusions:** This study evaluated a robust and ethnically diverse population of patients at a major university clinic in Los Angeles, and identified important clinical parameters associated with lichen planus. Since oral lichen planus is a relatively common condition encountered in dental practice, data and studies like this are relevant to clinicians to inform the natural history of disease and risk factors.

Poster #30

Title: Evaluation of the Quality of Reporting in Systemic Reviews In Periodontal Journals – A Cross Sectional Survey

Authors: Jassem Alsharah, Shira Scholten, Kian Kar and Satish Kumar

Faculty advisor: Kian Kar

Background: Systematic reviews with or without meta analyses have been integral in decision making. Stringent research criteria must be followed to publish a high quality Systematic Reviews in order to attain clinically relevant answers. Validated instruments have been developed to assess the quality of SR such as the Assessment of Multiple Systematic Reviews (AMSTAR) and a checklist by Glenny and colleagues. **Purpose:** To assess the quality of reporting of Systematic Reviews with or without meta-analyses in two widely read periodontology journals; Journal of Periodontology (JoP) and Journal of Clinical Periodontology (JCP) published in the years 2013 and 2018. **Methods:** Electronic and manual search using Medline database of JoP and JCP was done independently by two reviewers. AMSTAR statement and Glenny's checklist were used to evaluate the reporting quality of the selected Systematic Reviews from both journals. The percentage of the number of articles fulfilling each item in each checklist for the years of 2013 and 2018 were calculated and descrip-

tive statistics were used to analyze the data in addition to the trends in the quality of reporting. **Results:** In both JOP and JCP, systematic reviews published in 2013 and 2018 show a wide range of adherence to difference items in both checklists ranging from 37.5-100% in AMSTAR and 25-100% in Glenny's. **Conclusion:** The quality of reporting of SR in JoP and JCP according to AMSTAR statement and Glenny's checklist can be improved in the areas identified within this study.

Poster #31

Title: Photoacoustic imaging for measuring periodontal phenotype

Authors: Christopher Pham, Jane Law, Colman Moore, Jesse Jokerest and Casey Chen

Faculty advisor: Casey Chen

Comprehensive periodontal examination requires clinical evaluation utilizing a periodontal probe. However, the periodontal probe suffers from poor reproducibility amongst operators due to angulation, magnitude of force, tooth anatomy, and inflammation. In addition, periodontal measurements are often limited to six points around a tooth circumferentially. Photoacoustic-ultrasound imaging is a noninvasive technique that spatially resolves the periodontal anatomy, allowing for visualization of the free gingival margin, gingival thickness, and the gingival sulcus.

Poster #32

Title: Dental norms and characteristics in a Vietnamese population

Author: Cameron Freelove

Faculty advisor: Glenn Sameshima

Background: Many of the dental norms used in orthodontic treatment planning are based on Caucasian peoples. There is limited research on

dental norms for Vietnamese peoples, which hinders the orthodontist's ability to properly treatment plan for Vietnamese patients. **Purpose:** The purpose of this study is to help create a reference that outlines an overview of the dental characteristics of the Vietnamese people. **Methods:** Initial records (plaster study models) of 159 patients (49 male, 110 female) of Vietnamese descent were collected from a private orthodontic practice in Southern California. All the models were analyzed and recorded by two investigators for the following measurements: Angle classification, overbite, overjet, presence of tooth shaped incisors, presence of anterior and posterior crossbite, arch form, crowding, and Bolton discrepancy. **Results and Conclusions:** The subjects showed Angle molar classification in decreasing frequency from class 1, 2, and 3. The mean overjet and overbite values were greater than established ideal norms. Shovel shaped incisors were present in 57.2% of the subjects, which is consistent with Mongoloid dental features. Posterior crossbite of at least one tooth was present in 23% of the subjects, anterior crossbite of at least one tooth was present in 32% of the subjects. Ovoid was the most common arch form, followed by square, and then tapered. On average, subjects exhibited mild to moderate crowding. Bolton's tooth sized ratios can be used appropriately for Vietnamese peoples.

Poster #33

Title: Association of oral health and nutritional status in older adults: A systematic review with meta-analyses

Authors: Sahar Hussein, Rifat Falak Kantawalla, Stephenie Dickie, Piedad Suarez-Durall, Roseann Mulligan and Reyes Enciso

Faculty advisor: Reyes Enciso

Background: Poor general and oral health are interrelated, especially among elders. Thus, the early detection of malnu-

trition would be an important step toward the provision of necessary health care for older people whose oral health is compromised. **Purpose:** To evaluate whether poor oral health is associated with a higher risk of malnutrition in older adults. **Methods:** Cohort and cross-sectional studies with adults 65 years and older, reporting oral health and nutritional outcomes based on either MNA (Mini Nutritional Assessment) or MNA-SF (short form). Four databases were searched (PubMed, Web of Science, Cochrane Library and EMBASE) through 2/2019. Risk of bias was assessed with the checklist by the Agency for Healthcare Research and Quality scale. **Results:** A total of 923 abstracts were reviewed. Meta-analyses showed that the lack of daily oral hygiene (teeth/denture cleaning), chewing problems and being partially/fully edentulous put elders at higher risk of malnutrition ($p < 0.05$). After adjustment for socio-demographic variables, the included studies in the systematic-review reported lack of autonomy for oral care, poor/moderate oral health, no access to the dentist and being edentulous with either no dentures or one denture were risk factors significantly associated with a higher risk of malnutrition ($p < 0.05$). **Conclusions:** Findings may imply that once elders become dependent on others for assistance with oral care, have decreased access to oral healthcare, and lack efficient chewing capacity, there is increased risk of malnourishment. Limitations of the study include heterogeneity of oral health variables and the observational nature of the studies. Further studies are needed.

Poster #34

Title: Loneliness, Depression and their Relationship to Oral Health Findings of Older Adults

Authors: Stephanie Ritchey, Piedad Suarez-Durall, Reyes Enciso and Roseann Mulligan

Faculty advisor: Piedad Suarez-Durall

Background: Older adults are at higher risk of loneliness and depression, which are associated with a decrease in quality of life and health. Studies have shown a relationship between loneliness and a decrease in cognitive function, increase in depression, increase in morbidity, mortality and cardiovascular disease. **Purpose:** Investigate the association of loneliness with oral health in older adults. **Methods:** Data was collected from adults ≥ 65 years at different locations in Los Angeles, using the 3-item UCLA Loneliness Scale; the Center for Epidemiologic Studies Depression Scale; the Oral Health Impact Profile (OHIP-14) and the oral health screening of the Association of State and Territorial Dental Directors (ASTDD). **Results:** We enrolled 43 participants ≥ 65 years with an average age of 73.0 ± 6.1 (SD) (21 males and 22 females). There was no association between loneliness or depression with any of the clinical oral findings or OHIP-14. Lonely people (a score of > 6) had a significantly higher average depression score than those not lonely (13.1 ± 6.7 versus 3.7 ± 3.3 ; $p < 0.001$). Patients with higher negative impact of oral health (measured with OHIP-14) had lower numbers of upper ($p = 0.04$) and lower teeth present ($p = 0.005$), more gingival inflammation ($p = 0.01$), higher tooth mobility ($p = 0.029$), more need for periodontal care ($p = 0.015$) and lacked functional posterior occlusal contacts ($p = 0.006$). **Conclusion:** A significant positive association was found between loneliness and depression. While similar rates of oral pathology were found when compared to the California Report, there has yet to be an association found between oral health and loneliness or depression.

Poster #35

Title: Efficacy of FAST Promotion in Treatment of Gingival Recession Defect

Authors: Navid Nobaharestan, Shahriar Agahi, Alexandre Aalam, Alina Krivitsky and Neema Bakhshalian

Faculty advisor: Neema Bakhshalian

Various surgical techniques and biomaterials have been introduced for the treatment of gingival recession over the last decades. These procedures are aimed to improve esthetics, augment root coverage to prevent dental hypersensitivity and root caries, and increase soft tissue thickness to prevent progression of recession. The aim of this study was to evaluate the efficacy of a novel technique, Fibrin Assisted Soft Tissue Promotion, for treatment of recession defects in multiple adjacent teeth. Patients ($n = 13$) with ambulatory medical histories were enrolled in the study. Each patient was treated with a soft tissue graft via vestibular tunneling and Platelet Rich Fibrin (APRF) membranes. Baseline and post-op (6-18 months) intraoral scans of each treated tooth were superimposed via Geomagic software. 2-D and 3-D measurements were analyzed. Thirteen patients ($n = 13$ for 2-D analysis, $n = 10$ for 3-D analysis) were included in the measurements. All patients healed uneventfully. The mean root coverage, percentage of complete root coverage, and the gained volume were quantified. The data will be presented at The Annual USC Research Day. Fibrin-Assisted Soft-Tissue (FAST) Promotion is an effective technique for treatment of multiple adjacent recession defects.

Poster #36

Title: Does waxing impression technique distort the final impression?

Author: Kuan-Ming Chiu

Faculty advisor: Winston Chee

Background: Recording tooth structure beyond the margin plays a key role in fabricating full coverage restorations. The impression material extruded into the gingival sulcus forms a thin skirt of material around the finishing line, which indicates successfully capturing the margin of tooth preparation. Waxing impression technique,

which was first described by Mojmir Vacek in 1965, is a modification of the impression prior to pouring the cast. The procedure uses an adhesive wax to thicken the skirt of impression material in order to more clearly define the preparation finish line. This step also protects impression material from being torn after separating from the stone cast. However, the wax shrinkage from molten to solid phase may present a risk of impression distortion. **Purpose:** To investigate absence or presence of distortion of the impression after using the waxing impression technique. **Methods:** A metal cylinder with 1 mm margin preparation and sleeve forming a 0.2 mm space between were prepared as a standard model. 20 prosthodontics residents in USC were selected to execute PVS impression taking and impression modification. 10 of the 20 did impression taking only as a control group. 3D scanning of the impression with and without waxing impression technique were compared. **Results:** There is no significant difference between PVS impression with and without waxing impression technique use. **Conclusion:** The waxing impression technique does not affect the accuracy of the PVS final impression.

Poster #37

Title: Comparison of Two Oral Meperidine Drug Regimens: A Retrospective Study

Authors: Jonathan Chay, Thomas Tanbonliong and M. Wilson

Faculty advisor: Thomas Tanbonliong

Purpose: 1) Determine the effectiveness of two oral meperidine drug regimens in sedating children for dental treatment. 2) Assess whether pre-sedation behavior, willingness to take radiographs and willingness to take the sedatives are correlated with sedation success. **Methods:** The electronic dental records of 451 children who were sedated with one of two oral meperidine regimens were evaluated. Children were

sedated with either: I: Meperidine, Hydroxyzine, and Midazolam (MHM) or II: Meperidine, Hydroxyzine, and Diazepam (DHM). Data collected included: pre-sedation behavior, willingness to take radiographs and sedatives, effectiveness of the sedation, and occurrence of any intraoperative adverse events. The data was analyzed with descriptive statistics, logistic regression, the Wilcoxon Rank Sum test and Chi Square test via Stata 15.0. **Results:** The proportion of effective sedations in the MHM group was 66.2% (47 out of 71) vs. 79.7% (303 out of 380) in the DMH group respectively. Intra-operative adverse events occurred more frequently in the MHM group (11.4%) compared to the DMH group (4.2%) [P=0.037]. After adjusting for fearfulness, whether a pre-operative radiograph was taken, and pre-operative cooperation, children sedated with DHM were 88% more likely to have an effective sedation (OR=1.88, 95% CI: 1.02, 3.48, p=0.043). **Conclusion:** Children sedated with DHM were more likely to have an effective sedation with less intraoperative adverse events. A child who is willing to take pre-operative radiographs, and who has higher pre-operative cooperation is more likely to have an effective sedation.

Poster #38

Title: Cephalometric norms for the Vietnamese: a clinical appraisal

Authors: James Spencer Bisbas and Glenn Sameshima

Faculty advisor: Glenn Sameshima

Background: Lateral Cephalometric radiographs are used in many orthodontic offices to help diagnose the patients. Many of the analyses associated with these are based off of norms that were established from a Caucasian population. There is limited information for the Vietnamese population. **Purpose:** To help establish cephalometric measurements that are more representative of the Vietnamese people while

directly evaluating the differences to established norms. **Methods:** A Steiner, Tweed, and Wits cephalometric analysis was completed on 104 lateral cephalometric radiographs for Vietnamese individuals using the Dolphin Imaging program. Twenty-eight parameters were recorded. Descriptive statistics were done using Microsoft Excel. **Results:** The mean ANB was found to be 2.3 ± 2.8 degrees. Mean Wits was found to be -1.8 ± 4.3 mm. The U1-NA mean was found to be 32.8 ± 7.3 degrees with the L1-NB mean found to be 31.7 ± 6.9 degrees. The mean SN-GoGn of the sample was found to be 29.3 ± 6.0 degrees. Soft tissue measurements were found to be 1.1 ± 2.6 mm and 3.4 ± 2.7 mm in relation to E-plane for the upper and the lower lip. **Conclusion:** The Vietnamese individuals tended to have increased U1-NA and L1-NB measurements leading to more protrusive dental characteristics. This is consistent with previous literature showing a more protrusive soft tissue profile when compared to Rickett's E-plane as well as the U1-SN parameter.

Poster #39

Title: Atypical trigeminal neuralgia presented as a lower incisor toothache in a 73 years old female patient

Authors: Chitra Priya Emperumal and Nour Dean Khalifeh

Faculty advisor: Mohammad Khalifeh

Background: Trigeminal neuralgia (TN) is a relatively uncommon disease with an annual incidence in the United States of 4:100,000 per year. TN mostly affects patients over the age of 50 but can occur at any age. Based on the clinical symptoms, TN have been classified into idiopathic or classical and symptomatic or secondary. Symptoms are similar in both groups but the etiologies are different. About 90% of patients with TN fall into the idiopathic category. The term, idiopathic is used when the underlying cause is

unknown; while symptomatic TN occurs secondary to another disease process such as a tumors, vascular malformation or a demyelinating disease such as multiple sclerosis. The peak incidence of idiopathic TN occurs between the ages of 50-70 with 90% of TN cases occurs after age 40 but the peak incidence of Idiopathic TN is between ages of 50-70. Women are more likely to be affected than men in both types. Symptomatic TN is more common in younger patients while idiopathic TN is more common in older patients. **Purpose:** The purpose of this paper is to educate dental professionals that toothache may not be caused by actual tooth problem. Dentists should think out of the box when diagnosis dental pain, they should perform treatment only after being sure about their diagnosis. This case report of atypical trigeminal neuralgia presented as a toothache that could took months or years before finding the correct diagnosis. This will be devastating to the patient and might subject the patient to unnecessary costly dental procedures. **Method:** A logical approach was used to reach the correct diagnosis in this case. It will be very likely to misdiagnose this case by focusing only on the clinical and radiological picture of the aching tooth. **Results:** Patient was treated successfully using Carbamazepine, an anticonvulsant medication commonly used for management of TN. **Conclusion:** Toothache might be a symptom of a problem that is not caused by the painful tooth.

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Poster #40

Title: Amelogenin-derived peptide P26 promotes collagen mineralization and dentin remineralization

Authors: Gayathri Visakan, Kaushik Mukherjee, Jin-Ho Phark and Janet Moradian-Oldak

Faculty advisor: Janet Moradian-Oldak

Background: Non-carious cervical lesions result from mechanical and chemical trauma to the enamel leading to dentin exposure. Treatment of demineralized dentin is challenging owing to an enzyme rich collagen matrix. Here, we used a rationally designed amelogenin peptide (P26) as an effective biomimetic strategy for the repair of superficial dentin. **Purpose:** To investigate the role of P26 in regulating the mineralization of collagen fibers in vitro, and in promoting functional remineralization of demineralized dentin in situ. **Methods:** For the in vitro mineralization experiments, collagen fibers that were first assembled on TEM grids (PBS, pH 7.0) and incubated in a metastable Ca-P solution, with and without P26 were examined under TEM. Mid-coronal dentin sections obtained from extracted human third molars were divided into Normal, Demineralized (pH 4.6), P26 treated and Control groups. After 10 days of remineralization in artificial saliva (pH 7.0), crystal morphology, orientation, and mineral density were analyzed using SEM, XRD, and Micro-CT. Hour glass shaped dentin specimens were prepared and tested under tension until fracture. **Results:** In vitro collagen mineralization in the presence of P26 resulted in the formation of amorphous calcium phosphate and small HAP crystals attached to the fibril surface. Following in situ dentin remineralization with P26, a dense coating of HAP crystals on the collagen fibers occluding dentinal tubules, a 10.74% gain in mineral density (n=10), and a 2.2-fold increase in tensile strength (n=10) was observed. **Conclusion:** Amelogenin-derived peptide P26 promotes collagen mineralization in vitro, and functional remineralization of partially demineralized dentin in situ.

Poster #41

Title: Protein Arginine Methyltransferase 4 is Essential in Posterior Frontal Suture Fusion

Authors: Nicha Ungvijanpunya, Yongchao Gou, Stephen Yen and Jian Xu

Faculty advisor: Jian Xu

Background: Protein Arginine Methyltransferase 4 (PRMT4) is an enzyme required for arginine methylation which plays important roles in several processes including bone development. Previous study has shown that mice with Prmt4 deletion died shortly after birth. During embryonic stage, these mice exhibited delay in endochondral bone formation and chondrocyte proliferation. However, PRMT4 role in osteogenic proliferation, formation, and differentiation has not been fully understood. The study from our lab has shown that PRMT4 methylates RUNX2 which is a master regulator for bone formation. Therefore, we deleted Prmt4 in the neural crest-derived tissue using a conditional knock out model to study the role of PRMT4 in cranial bone development, specifically neural crest-derived cranial bones. **Purpose:** We aim to investigate the role of PRMT4 in neural crest-derived cranial bone development. **Methods:** Control (*Prmt4^{fl/fl}*) and neural crest-specific *Prmt4* deletion mice (*Wnt1-cre;Prmt4^{fl/fl}*) were generated and collected at several timepoints (E16.5, E18.5, P0, P4, P7, 5-week, and 6-week old) MicroCT scanning and skeletal preparation were performed. The analysis was done for cranial bone parameter comparison between control and mutant group. Cellular and molecular mechanisms were studied. **Results:** We found that mice with neural crest-specific *Prmt4* deletion show open posterior frontal suture at 6-week old. MicroCT data also shows wider space between frontal bones in *Prmt4* deletion mice than control mice at P0 stage. **Conclusion:** Our data show that PRMT4 is important for fusion of the posterior frontal suture.

Poster #42

Title: Amelogenin-Ameloblastin Protein Interaction and Function in Dental Enamel Formation

Authors: Rucha Arun Bapat, Jingtian Su and Janet Moradian-Oldak

Faculty advisor: Janet Moradian-Oldak

Background: Enamel matrix proteins amelogenin (Amel) and ameloblastin (Ambn) colocalize in the secretory stage of amelogenesis and their fragments continue to colocalize in the maturation stage. However, evidence of direct binding and co-assembly between Amel and Ambn remains scarce. **Purpose:** To provide evidence of direct binding between Amel-Ambn and to propose a function of the interaction. **Methods:** Specific interaction between recombinant and native porcine Amel-Ambn was identified with co-immunoprecipitation (co-IP). The fragment of Ambn essential for binding to Amel was identified using Ambn mutants and synthetic peptides. Dynamic Light Scattering (DLS) and Transmission Electron Microscopy (TEM) were used to study the co-assembly of Ambn with Amel nanospheres. In vivo Amel-Ambn and Ambn-ameloblast cell membrane colocalization was studied in 8-day-old mouse incisors and ameloblast lineage cells (ALC). **Results:** Recombinant and native Amel-Ambn bind in vitro through the N-terminal fragment of exon 5 encoded region of Ambn. The peptide representing exon 5 encoded region of Ambn and full length Ambn co-assemble with Amel nanospheres in vitro, significantly decreasing their size. Full length Amel-Ambn colocalize within ameloblasts and at the Tomes' processes whereas the N-terminal fragments of Ambn colocalize with Amel throughout the thickness of the forming enamel. Ambn colocalizes with cell membrane of ALC and ameloblasts in developing incisor. **Conclusions:** We have demonstrated that Amel and Ambn bind to each other and Ambn binds

to ameloblast cell membrane at the secretory face of ameloblasts. We propose that Ambn acts as an adhesion molecule between ameloblasts and Amel rich enamel extracellular matrix.

Poster #43

Title: Pull-off Bond-strength of Polymer-based Crowns to CAD/CAM Prepared Human Teeth

Authors: Reham Alsamman, Neimar Sartori, Sillas Duarte and Jin-Ho Phark

Faculty advisor: Jin-Ho Phark

Purpose: Evaluate the adhesive performance of crowns made of two CAD/CAM materials bonded to natural teeth using six resin cements. **Methods:** A standard preparation (3 mm height, 6° axial convergence, 0.5 mm chamfer finish line) was designed and prepared into 144 human molars using a CAD/CAM milling machine (CEREC inLab MC XL). Crowns were designed and milled out of two polymer-based CAD/CAM materials (LuxaCam, DMG; Lava Ultimate, 3M). After sandblasting the internal surface of each crown (50 µm Al₂O₃, 13 s) and cleaning (ethanol in ultrasonic bath, 5 min), the crowns were cemented with one of six cements (1. experimental cement, 2. RelyX Ultimate, 3. DuoCem, 4. Multilink Automix, 5. RelyX Unicem2, 6. Ketac Cem Plus), according to the manufacturers' instructions. All crowns were seated onto the preparation using a seating device and light cured for 20 s/ surface using LED curing unit. Specimens were subjected to artificial aging by thermo-cycling (20K cycles at 5°C-55°C, immersion time 30 s, transfer time 10 s), 6 months of water storage at 37°C, and cyclic fatiguing (1.2M cycles at 1.6 Hz, 49 N load). Pull-off bond strength was measured using a universal testing machine by loading specimens until failure. Failure mode was reported. Statistical analysis was performed using Mann-Whitney U tests at α=0.001. **Results:** There was

no significant difference in the bond strength among LUX groups nor LAV groups except LAV/ RelyX Unicem 2 **Conclusion:** The adhesive performance of both polymer-based crown materials to CAD/CAM prepared human teeth was comparable. However, the performance was cement dependent.

Poster #44

Title: Interferon-independent Title: Switch of macrophage fusion competency by 3D matrices

Authors: Josephine Y. Fang, Zhi Yang and Bo Han

Faculty advisor: Bo Han

Foreign body reaction reflects the integration between biomaterials and host cells. At the implantation microenvironment, macrophages usually fuse into multinuclear cells, also known as foreign body giant cells, to respond to the biomaterial implants. To understand the biomaterial-induced macrophage fusion, we examined whether biomaterial alone can initiate and control the fusion rate without exogenous cytokines and chemicals. We introduced a collagen-based 3D matrix to embed Raw264.7 cell line and primary rat bone marrow derived macrophages. We found the biomaterial-stimuli interacted regional macrophages and altered the overall fusogenic proteins expressions to regulate the macrophage fusion rate. The fusion rate could be altered by modulating the cell-matrix and cell-cell adhesions. The fused macrophage morphologies, the nuclei number in the fused macrophage, and the fusion rate were matrix dependent. The same phenomena also observed in the in vivo models. These results suggest that the biomaterial-derived stimuli exert similar functions as cytokines to alter the competency of macrophage fusion as well as their drug sensitivity in the biomaterial implanted tissue environment. Furthermore, this in vitro 3D-matrix model is potential to serve as a toolbox to predict

the host tissue response on implanted biomaterials.

Poster #45

Title: Role of Runx2 arginine methylation in functional interaction with its transcriptional co-factors

Authors: Prerna Sehgal, Yongchao Gou, Abhijit Shinde, Baruch Frenkel and Jian Xu

Faculty advisor: Jian Xu

Background: Runx2 is the master transcription factor for bone formation. Loss of Runx2 causes embryonic lethality by impaired mineralization of the skeleton. Because of its importance, Runx2 is tightly regulated by signaling pathways such as BMP and post-translational modifications to control its activity and expression. Our lab revealed novel methylation of Runx2 by protein arginine methyltransferases (PRMTs). Our Preliminary data shows that PRMT3 and 4 are highly expressed in the osteoblast lineages and catalyze Runx2 methylation at four specific arginine (R) residues, which lie within the transactivation/repression (TD) domain. **Purpose:** My project is centered around understanding the role of Runx2 arginine methylation in osteogenesis. **Methods:** I conducted co-IP assays to assess interactions between methyl-Runx2 and multiple known transcriptional co-factors including Sin3A, C/EBP β , HDAC6 and p-300. I am also using the in-vitro osteogenic differentiation model in ST2 cells to assess Runx2 methylation during osteogenic differentiation and Runx2 interaction with these co-factors. Using the APEX technique, I will further profile the major binding partner changes between wildtype and methylation-deficient Runx2. **Results:** Co-IP results showed that Sin3a and C/EBP β binds more strongly to methylated Runx2. In-vitro differentiation study will further shed light on the importance of methyl-Runx2 and its interaction with co-factors in driving osteogenesis. Furthermore, APEX studies will help in bind-

ing partner profiling. **Conclusion:** Co-IP results suggest that methylation of Runx2 is important for its interaction with Sin3A and C/EBP β . Findings from this study will uncover new regulatory mechanism for Runx2 and potentially identify new therapeutic approaches for skeletal disease.

Poster #46

Title: Determination of Mineral Density of Remineralized Enamel and Dentin: A QLF study

Authors: Garima Sandhu and Janet Moradian-Oldak

Faculty advisor: Janet Moradian-Oldak

Background: QLF has been routinely employed to study enamel defects, especially white spot lesions on teeth. Utilization of sodium fluorescein dye and QLF to monitor de- and re-mineralization of root dentin has also been recently reported (I.A. Pretty et al., 2003). **Purpose:** To employ QLF to quantify the changes in the fluorescence of enamel and coronal dentin when subjected to demineralization and remineralization in the presence of amelogenin derived peptide (P26). P26 has been shown to be effective in growing enamel like apatite crystals on etched enamel surface (Mukherjee et al., 2017). **Methods:** Cross-sections (1.5mm thickness) of extracted mandibular third molars were used. Two windows measuring 1 mm x 1mm were created on every section using clear varnish and were examined under QLF for generating baseline values. Enamel samples were demineralized for 72 hours whereas dentin samples were demineralized for 120 hours. Samples were analyzed under QLF at every step of the process. Enamel samples were compared between 4 groups whereas dentin samples between 2 groups with primary focus on remineralization in the presence of P26. **Results:** Gradual loss in fluorescence (decrease in ΔF) with respect to baseline val-

ues was observed during demineralization and the reverse (Increase in ΔF) was seen after remineralization. **Conclusion:** We conclude that QLF can be employed to study as well as quantify changes in enamel and dentin for better understanding of remineralization process.

Poster #47

Title: Role of Fgfr2 in the Development of the Frontal Suture

Authors: Lauren Bobzin and Amy Merrill

Faculty advisor: Amy Merrill

The anterior fontanelle (AF) is the fibrous soft spot in the front of an infant's head, which forms at the intersection of the frontal (metopic), coronal, and sagittal sutures. During postnatal development of the calvaria, closure of the AF correlates with formation of the posterior frontal suture (PFS). However, persistence or premature fusion of the AF in congenital disorders, such as cleidocranial dysplasia, campomelic dysplasia, and frontal suture craniosynostosis can distort calvarial growth and alter intracranial pressure. Fibroblast Growth Factor Receptor-2 (FGFR2) is a key regulator of calvarial development. This is underscored by human diseases caused by FGFR2 mutations, which often feature both fontanelle and suture defects. The overall goal of this proposal, therefore, is to use mouse genetics to identify the dual roles of Fgfr2 in the establishment and eventual lineage commitment of skeletal progenitor cells contributing to the formation of the AF and PFS. My preliminary studies demonstrate that conditional knockout of Fgfr2 in neural crest cell (NCC)-derived mesenchyme using the Wnt1-Cre driver delays AF closure and blocks formation of the PFS suture cartilage. This proposal will test the hypothesis that Fgfr2 regulates development of the AF and PFS by dually regulating specification and differentiation of SOM-derived Scx+/Runx2+ and EMM-derived Scx+/Sox9+ skeletal

progenitors. Completion of this study will reveal a mechanism that controls development of the anterior fontanelle and posterior frontal suture, as well as advance our understanding of cell fate choice during calvarial patterning.

Poster #48

Title: Investigating Craniosynostosis in Mice with Bent Bone Dysplasia Syndrome

Authors: Audrey Nickle and Amy Merrill

Faculty advisor: Amy Merrill

Craniosynostosis, which is the premature fusion of one or more suture joints in the skull, is the second most common congenital craniofacial birth defect. There are a number of documented skeletal dysplasias which results in craniosynostosis, many of which are caused by mutations to the protein FGFR2. The Merrill lab has identified a unique FGFR2 mutation that causes Bent Bone Dysplasia Syndrome (BBDS), a lethal skeletal disorder featuring craniosynostosis as a key phenotype. BBDS-causing mutations, which are within the transmembrane domain of FGFR2, promote nuclear localization of the receptor where it affects gene expression. Our published studies have shown that these FGFR2 mutations in BBDS enhance proliferation and delay differentiation of osteoprogenitor cells, but the connection between these cellular changes and craniosynostosis remains poorly understood. The goal of my research is to outline this connection by using our newly developed Cre-inducible mouse model for BBDS. Here I demonstrate that this mouse, which expresses the *Fgfr2^{M391R}* mutation causative for BBDS, develops progressive pan-suture fusion postnatally when activated using the neural crest cell (NCC)-specific Wnt1-Cre inducer. Since craniosynostosis in these mice is observed in not only NCC-derived sutures, but also mesoderm-derived sutures where only the underlying dura is NCC-derived, this suggests that dura ex-

pressing *Fgfr2^{M391R}* non-autonomously disrupts suture maintenance. By using lineage tracing, we investigated potential disruptions in the mesoderm-NCC boundary which may be causative of craniosynostosis. Research in this ongoing study will contribute to the model of disease progression within BBDS human patients.

Poster #49

Title: Quality of life of adolescents with cleft lip and palate undergoing orthodontic treatment

Authors: Janice Lee and Stephen Yen

Faculty advisor: Stephen Yen

Purpose: Cleft lip and palate (CLP) is the most common craniofacial birth defect in humans. Adolescents with facial differences are at higher risk for psychosocial difficulties that can affect their quality of life (QoL). Little is known about the QoL of patient with CLP or whether a patient's self-perception changes at stages of treatment. We hypothesize improved QoL at maximal correction of malocclusion relative to pretreatment. **Methods:** Patients with CLP undergoing either late maxillary protraction (n=50) or orthognathic surgery (n=50) for CI III malocclusion were given QoL questionnaires at two times points: pretreatment (T1) and in the middle of treatment at maximal correction (T2) of malocclusion. Validated Facial Differences Module of Youth Quality of Life (yQOL-FD) and 12-item Short-Form Health Surveys (SF-12) were distributed to late maxillary protraction patients (11-14 years old) and orthognathic surgery patients (16-21 years old) to assess QoL before treatment as a baseline (T1) and in the middle of treatment (T2). **Results:** There were few differences in answers between the two age groups and timepoints. The SF-12 results showed statistically significant decrease (p<0.05) in Protraction participants in feeling that they have a lot of energy all the time from

T1 to T2. The Surgery participants showed a statistically significant increase (p<0.05) in feeling that their physical health or emotional problems did not interfere with their social activities. **Conclusion:** The SF-12 and yQOL-FD results demonstrate unexpected stability in QoL from pretreatment to maximal correction of CI III malocclusion suggesting an adolescent's self-esteem and evaluation of health may be dependent on factors other than treatment interventions.

Poster #50

Title: Protein Deamidation Mediated Metabolic Reprogramming During KSHV Lytic Replication

Authors: Mao Tian, Shu Zhang, Youliang Rao, Jun Zhao, Alireza Delfarah, Nicholas A. Graham and Pinghui Feng

Faculty advisor: Pinghui Feng

Kaposi's sarcoma-associated herpesvirus (KSHV) is an oncogenic virus that causes Kaposi's Sarcoma (KS) and B cell lymphoma in immune-compromised individuals. Previous studies have shown that KSHV reprograms host metabolism to funnel metabolic activity to favor viral lytic replication. However, how KSHV reprograms metabolism remains unknown. Cellular glutamine amidotransferases (GATs) catalyze the synthesis of nucleotides, amino acids and enzyme cofactor that are building blocks of cells. We have previously shown that a cellular GAT can deamidate proteins to regulate innate immune response, suggesting that cellular GATs may potentially couple fundamental biological processes to cellular metabolic status via deamidation. We employed KSHV lytic replication in human oral keratinocytes to test this hypothesis. First, we performed proteomics and metabolomics analyses to profile the potential link between protein deamidation and metabolic reprogramming, which characterized a robust parallel activation in central carbon metabolism

and patterned deamidation in key glycolytic enzymes. While the glycolytic fluxes are being investigated with isotope labeling and tracing by mass spectrometry, protein deamidation is further delineated by biochemical assays and confirmed by mass spectrometry. Ongoing work is directed to delineate the protein deamidation events by identifying key deamidases that deamidate these glycolytic enzymes. We will then determine the role of selected protein deamidation in metabolic reprogramming and KSHV lytic replication. Our work will uncover key roles of protein deamidation in regulating metabolic enzymes in particular and metabolic reprogramming in general, expanding the functional repertoire of protein deamidation. Our findings will expose cellular molecules that are vulnerable to antiviral or antitumor therapy.

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Poster #51

Title: Treatment Management of High Coronal Root Fracture of Anterior teeth in Adolescent Patients

Authors: Nermin Batniji, Ankit Keshav and Edmond Onwukwe

Faculty advisor: Rafael Roges

Traumatic injury of permanent anterior teeth is commonly seen in adolescents. Trauma may result in loss of tooth structure, diminished pulp vitality and severe discomfort. This case report investigates treatment management of adolescent individuals that are still undergoing growth and development. Five cases amongst 4 patients with ages ranging from 9-18 years old presented to the Emergency Department. These teeth underwent sensitivity testing, and all required

endodontic therapy. As a result of the trauma, the teeth were separated into a coronal segment and a root segment due to horizontal or oblique fractures at the level of the CEJ. After the RCT, palatal and buccal flaps were released to isolate and bond the traumatized coronal segment to the root. In adult patients these teeth would be deemed non-restorable, however due to the age of these patients, a treatment alternative was presented. Cases involving trauma to adolescents with permanent teeth are time sensitive, and improper management could result in loss of dentition leading to loss of alveolar bone. Retention of these teeth are critical for the long term treatment of either space maintenance for an implant, or intentional extrusion to gain a coronal component. The purpose of this case series is to present treatment management options for adolescent patients in order to alleviate discomfort, and maintain their natural dentition during this critical growth time. These cases will illustrate diagnosis and treatment management of horizontal or oblique coronal fracture at the level of the CEJ in developing patients with follow-up outcomes.

Poster #52

Title: Runx2 regulates tooth root development via activation of Notum

Authors: Quan Wen, Junjun Jing, Xia Han, Jifan Feng, Yuan Yuan, Yuanyuan Ma, Shuo Chen, Jinzhi He, Thach-Vu Ho and Yang Chai

Faculty advisor: Yang Chai

Progenitor cells are crucial in controlling organ morphogenesis. Tooth development is a well-established model to investigate the molecular and cellular regulatory mechanisms in regulating organogenesis. Despite advances in our understanding of the regulatory mechanism of tooth crown formation, we have limited understanding about tooth root development. Runx2 is a well-known transcription factor

of osteogenic differentiation and early tooth development. However, the function of Runx2 during tooth root formation remains unknown. In this study, we discovered that Runx2 is specifically expressed in a subpopulation of root progenitor cells and loss of Runx2 in these progenitor cells and their progeny results in root developmental defects. Our results provide the first in vivo evidence that Runx2 plays a crucial role in tooth root development and determining the differentiation of root progenitor cells. Furthermore, we identified that Gli1, Pcp4, Sfrp2, and Notum are downstream targets of Runx2 by using an integration analysis of bulk RNA sequencing and single-cell RNA sequencing. Specifically, ablation of Runx2 results in downregulation of Wnt inhibitor Notum and upregulation of canonical Wnt signaling in the odontoblastic site, which disturbs normal odontoblastic differentiation. Significantly, exogenous Notum partially rescues the impaired root development in Runx2 mutant molars. Collectively, our study elucidates how Runx2 achieves functional specificity in regulating the development of diverse organs and yields new insights into the regulatory network of tooth root development.

Poster #53

Title: MSCs and 3D-printed scaffold regenerate critical-sized calvarial defects in swine

Authors: Zoe Johnson, Xiangjia Li, Yuan Yuan, Tea Jashashvili, Yong Chen and Yang Chai

Faculty advisor: Yang Chai

Background: Head trauma, congenital defects, disease, and tumor resection can leave patients with large, full-thickness calvarial defects that are incapable of healing on their own. These critical-sized defects (CSDs) are currently repaired using inferior metal or plastic implants. Bone grafting causes additional trauma to the body which should be

avoided if possible. There is a significant need for improved treatment of calvarial CSDs. **Purpose:** In this study we compared efficacy of dental pulp neural crest mesenchymal stem cells (DPNCCs) and bone marrow aspirate (BMA) for regenerating calvarial bone in a CSD. **Methods:** Autologous DPNCCs obtained from the swine incisor were expanded over 2 weeks. BMA was collected from the swine tibial crest. A 3cm defect was made in the calvaria. The cells were combined with a 3D-printed osteoconductive hydroxyapatite and tricalcium phosphate scaffold and placed into the defect site. **Results:** We have defined a CSD model in the swine calvaria as 3cm diameter over a 12-week timepoint. DPNCCs or BMA combined with our 3D-printed scaffold successfully regenerated complex cortical bone that integrated with native bone in this model. Density, compression, and trabecular analyses indicated the regenerated bone was of good quality and sound structure compared to native bone. **Conclusion:** We have successfully regenerated cortical bone in the swine calvaria using two cell sources (DPNCCs and BMA) combined with an osteoconductive 3D-printed scaffold. This represents a unique opportunity to utilize cell-mediated tissue regeneration in improving care for human patients with calvarial CSDs.

Poster #54

Title: Flipped Classroom Inter-professional Education (IPE) for International Dentists

Authors: Anna Chen, Robin Fox and Mahvash Navazesh

Faculty advisor: Mahvash Navazesh and Robin Fox

Background: IPE sessions using a case-based faculty panel presentation (CFPP) was provided to international dentists enrolled in USC's Advanced Standing Program in Dentistry (ASPID). The Classes of 2018 (n=33), 2019 (n=31), 2020 (n=34) and 2021 (n=32) repre-

sented 9 to 17 countries. **Purpose:** To access the effectiveness of CFPP, and whether IPE had an impact on international dental students' career planning. **Methods:** Students were required to review information about a hypothetical medically complex patient and practice scope of 9 health professions (HPs): Dentistry, Dental Hygiene, Medicine, Physician Assistant, Pharmacy, Occupational Therapy, Physical Therapy, Nursing and Social Work. During an in-class Session, students then planned together to manage the patient, with help of faculty from the 9 HPs. Anonymous pre- and post-Session surveys were given, including same multiple-choice questions, plus 2 open-ended questions on the post-Session survey. An IRB waiver was obtained. **Results:** Responses from the classes of 2018, 2019, 2020 and 2021 went from pre-Session "moderately agree" to post-Session "strongly agree" in constructively expressing ideas (40%, 42%, 32% and 38%) and listening to an IP team (24%, 33%, 32% and 26%). All agreed the Session improved their knowledge of different HPs (95%, 100%, 100% and 94%). Post-Session survey reported different HPs' roles and observing collaborative practice in action as the most rewarding information. Upon graduation, classes of 2018 and 2019 reported that IPE had an impact on their career plans (65% and 50%). **Conclusion:** Case-based flipped classroom IPE is effective for international dentists, and may broaden their career planning perspectives.

Poster #55

Title: FaceBase3: Craniofacial Development and Dysmorphology Data Management and Integration Hub

Authors: Thach-Vu Ho, Robert Schuler, Cristina Williams, Bridget Samuels, Yuan Yuan, Joseph Hacia, Yang Chai and Carl Kesselman

Faculty advisor: Yang Chai

Background: The major goal of

the FaceBase Consortium is to advance research by creating a comprehensive repository of datasets on craniofacial development and dysmorphologies, and disseminating these datasets to the research community. **Purpose:** The FaceBase 3 Data Management and Integration Hub builds on the existing and successful scientific and technical team that has led the development, deployment, operation and community engagement of the FaceBase 2 data hub. Looking forward to the future impact of the FaceBase Consortium, we face major challenges that include (1) how to annotate large datasets to empower the biomedical research community; (2) how to improve data integration and facilitate data search and retrieval from the hub; (3) how to use the data from FaceBase to design studies and otherwise inform our future research; and (4) how to translate our knowledge from animal model studies to improve human craniofacial health. **Methods:** FaceBase provides innovative tools for the identification, retrieval, display, curation, and analysis of data on human and animal models of craniofacial development and disease. **Results:** FaceBase currently includes over 850 datasets from human, zebrafish, mouse, and chimpanzee. Alongside these models, chick and xenopus data represent priorities. We are also expanding our data repository to include morphological and functional data on tooth development. **Conclusion:** FaceBase seeks to provide a comprehensive, trustworthy data repository and educational resource on craniofacial development, through ensuring that contributed datasets are findable, accessible, interoperable, and reusable. FaceBase promotes multidisciplinary collaboration and research in craniofacial development, molecular genetics and genomics.

Poster #56

Title: Smcr8 deficiency disrupts axonal transport-dependent lysosomal function

Authors: Chen Liang, Qiang Shao, Wei Zhang, Mei Yang, Qing Chang and Jian-Fu Chen

Faculty advisor: Jian-Fu Chen

Background: G4C2 repeat expansions in an intron of *C9ORF72* cause the most common familial amyotrophic lateral sclerosis and frontotemporal dementia. Haploinsufficiency of *C9ORF72* protein is a key proposed disease mechanism which may act in parallel with gain-of-function mechanisms, including toxic RNAs from repeat transcription and dipeptide repeat proteins from repeat-associated non-AUG translation. **Purpose:** Investigation of in vivo function of *C9orf72* and *Smcr8*. **Methods:** Mouse genetics, immunostaining, behavioral experiments, and live imaging. **Results:** We crossed *C9orf72*^{+/-} mice with C9-BAC mice and examined the consequences of *C9orf72* protein dose reduction in the background of C9-BAC. We found that *C9orf72* loss and haploinsufficiency exacerbate motor behavior deficits in a dose-dependent manner. *C9orf72* and *Smcr8* form a protein complex. Expression of *Smcr8*, like *C9orf72*, is reduced in C9ALS/FTD mouse models and patient tissues. Since *Smcr8* is highly conserved between human and mouse, we evaluated the effects of *Smcr8* downregulation in mice. *Smcr8* knockout mice exhibited motor behavior deficits, which resemble those of C9ALS/FTD mouse models, and displayed axonal swellings in their spinal cords and neuromuscular junctions. These deficits are caused by impaired autophagy-lysosomal functions due to disrupted axonal transport in mutant motor neurons. Consistent with its interaction with *C9orf72* and their downregulation in patient tissues, *Smcr8* deficiency exacerbated autophagy-lysosomal impairment in *C9orf72* KO mice. **Conclusion:** *Smcr8* deficiency impairs axonal transport dependent autophagy-

lysosomal function and exacerbates axonal degeneration in C9ALS/FTD mouse models.

Poster #57

Title: The Role of Fgfr2 Within Scx-expressing Cells of Hair Follicles

Authors: Yi Sui, Ryan Roberts and Amy Merrill

Faculty advisor: Amy Merrill

Background: Fgfr2 and its main ligands FGF7, 10 play an important role in hair follicle development and regeneration. However, currently, the functional role of FGFR2 in hair follicle stem cells and postnatal hair cycling is not well understood. During our analysis of *Fgfr2*^{flx/flx}; *Scx-Cre* mice, we noted that the mice had abnormally matted and unkempt appearance with thinner hair shaft, unstructured hair medulla, and progressive hair loss. **Purpose:** Understand the role of Fgfr2 within the Scx+ cells of the hair follicle. **Methods:** Genetic lineage tracing; IF; RNA scope; H&E staining. **Results:** Scx+ cells mark stem cells that give rise to multiple cell subpopulations in hair follicles, as well as other important appendageal structures. Scx and Fgfr2 co-localize in hair matrix cells, which are the transient amplifying cells derived from stem cells. Depletion of Fgfr2 in the matrix cells alter their ability to respond to the pro-proliferative FGF7 and 10 signals, which is critical for the hair reenter anagen phase and form normal hair medulla structure. Eventually this disruption in Fgfr2 signaling leads to abnormal hair phenotype and progressive hair loss. **Conclusion:** Fgfr2 is important for hair follicle stem cell activation and controls the hair shaft medulla structure formation. The co-expression of Scx in the bulge, APM and DP raises the possibility of common signaling in all these structures and extends our understanding of the pathogenesis of the hair phenotypes in the FGFR2-related disorder.

Poster #58

Title: Denture adhesives in complete edentulous denture wearers. A systematic review

Authors: Neveen Elabbasy, Philip Morton and Tae Jun Ahn

Faculty advisor: Reyes Enciso, Roseann Mulligan and Phuu Han

Background: Denture wearers are often confronted with a varying degree of loss of retention and the resulting reduction in masticatory function. The use of denture adhesive has long been considered an useful adjunct treatment for the improvement of denture retention, stability and overall function. **Purpose:** The purpose of this research was to evaluate the efficacy of denture adhesives (DAs) in completely edentulous denture wearers compared to those same patients not using DAs. **Methods:** Four databases were searched (PubMed, Web of Science, Cochrane Library and EMBASE) through 2/2020. Only RCTs involving patients with complete dentures in both arches where the use of DAs was compared to no use of DAs were included. Outcomes included improvement in retention, stability, chewing ability and masticatory performance. The Cochrane Collaboration's tool assessing the risk of bias was used. **Results:** A total of 497 abstracts were reviewed, resulting in inclusion of 10 RCTs with 503 patients. All ten studies were assessed at high risk of bias. A meta-analysis could not be performed due to the heterogeneity of the outcomes reported by the authors. Individual included studies showed favorable results for DAs compared to no DA for retention/chewing. **Conclusion:** Due to the heterogeneity of the outcomes and high risk of bias, the quality of the evidence was low. Individual studies showed favorable results for DAs which might increase the edentulous patient's comfort and satisfaction. More research is needed in this area to study the impact of long-term use of DA and the effect on denture retention and stability.

Poster #59

Title: The role of Runx2 in tendon-bone attachment unit development

Authors: Siyan Wang, Ryan Roberts and Amy Merrill

Faculty advisor: Amy Merrill

Background: The enthesis is the graded connective tissue between bone and tendon, dissipates the force from contracting muscle to bone. This tissue is prone to injury, but current treatments are not ideal, and its formation during embryonic development is not thoroughly studied. Previous studies have shown that the tendon-bone attachment unit is formed modularly by a pool of Scx+/Sox9+ progenitor cells that forms the tendon's terminus and the bone eminence into which it inserts. **Purpose:** Studying the role of Runx2 in the development of the tendon-bone attachment unit at deltoid tuberosity in the limb. **Methods:** Skeletal preparations; HBQ staining; Immunofluorescence; RNA scope **Results:** Runx2 is co-expressed in Scx+/Sox9+ progenitor cells. Haploinsufficiency of Runx2 affects the development of deltoid tuberosity histologically by increasing the thickness of the perichondrium and delaying chondrocyte hypertrophy and ossification. In addition, the tendon insertion is also disrupted. **Conclusion:** Runx2 is expressed by Scx+/Sox9+ progenitor cells forming and is necessary for their differentiation into bone eminence.

Poster #60

Title: Regulation of the mesenchymal stem cell niche in mouse incisor

Authors: Josephine Ekholm, Aileen Ghobadi, Arman Ohanyan, Eva Janečková and Yang Chai

Faculty advisor: Yang Chai

Background: Mesenchymal stem cells (MSCs) located in the proximal end of mouse incisors enable continual growth of these teeth throughout the entire lifespan of the animal.

MSCs are important in regeneration and adult tissue homeostasis. The progeny of MSCs are transient amplifying cells (TACs). The rate of MSC to TAC transition and subsequent rates of TAC proliferation and differentiation into odontoblasts and dental pulp cells maintain incisor homeostasis. These processes are crucially regulated by the microenvironment, called the stem cell niche, where MSCs reside. **Purpose:** To explore the largely unknown signaling network that guides the fate of MSCs as well as their niche. **Methods:** RNAscope, immunofluorescence, and histology of *Gli-CreER;Tgfb β 2^{fl/fl}* and *Gli-CreER;Smo^{fl/fl}* conditional knockout mice and *Gli1-LacZ* reporter mice. **Results:** Both *Gli-CreER;Smo^{fl/fl}* and *Gli-CreER;Tgfb β 2^{fl/fl}* mice display impaired odontogenesis 2 months after tamoxifen injection; their dentinogenesis and amelogenesis are increased. The proliferation activity in the area of cervical loop where TACs are located is impaired, both in the mesenchyme and epithelium, resulting in premature differentiation of odontoblasts and ameloblasts that in *Gli-CreER;Smo^{fl/fl}* can already be observed two weeks after tamoxifen induction. Of particular interest is the impaired expression of Axin2, Dspp and Pax9 representing individual cellular identities in the mice incisors. **Conclusion:** Tgf- β and Shh signalling play crucial roles in stem cell niche regulation, homeostasis of the mouse incisor and consequently odontogenesis. Further functional experiments are necessary to reveal the exact role of these signalling pathways in the regulation of MSC fate and the incisor stem cell niche.

Poster #61

Title: Supporting Teaching Excellence with Implementation of Faculty-Developed and Transparent Peer-Review

Authors: Jennifer Jordan and Mahvash Navazesh

Faculty advisor: Mahvash Navazesh

Background: Student evaluations of teaching (SET) have historically been utilized for faculty evaluation; however there is no significant correlation between SET ratings and learning (Uttl 2017). There is also a paucity of PRT research in dental literature. Therefore, we aim to expand our well-established and criteria-based performance evaluation to include PRT, aligned with the university-wide Excellence in Teaching (EIT) initiative. **Purpose:** To develop and implement Peer-review of Teaching (PRT) at the Herman Ostrow School of Dentistry. In our opinion, to reduce bias, self- and peer-assessment, supported by faculty development programs, should be transparent, metric-based, accessible, and developed with faculty. **Methods:** In 2001, the School implemented an annual faculty self- and chair-evaluation process. Since then 2,878 evaluations (484 unique faculty) have been performed and utilized for faculty-development and promotion. A supplemental PRT initiative, facilitated by the Executive Associate Dean, was launched in 2018. Faculty participation in process development includes 2 workshops (December 2019), 6 division meetings (December 2019-March 2020), 3 DFA meetings (June 2018-September 2019), and an RTPC-PRT taskforce. All relevant materials were posted on the School's intranet with opinions solicited from all faculties. **Results:** Faculty developed the School's EIT Definition, a peer-observation (POB) checklist, and an evolving PRT process and implementation plan (June 2018-July 2020). There is both PRT interest and apprehension among faculty. Challenges identified include time commitment, training and consistency, ensuring faculty ownership, confidentiality of individual outcomes, review frequency, and application across instructional sites. **Conclusion:** Our observations are similar to what is recorded by Cunningham (2017), O'Keefe (2009), and Wingrove (2018). The School's evolving PRT practices are on track to evaluate effectiveness and reduce systemic bias.

Poster #62

Title: Coronoid Hyperplasia: A Case Report and Literature Review

Authors: Mary Ellen S. Chalmers, Chitra Priya Emperumal, Kamal Al-Eryan and Mariela Padilla

Faculty advisor: Kamal Al-Eryani

Background: Coronoid hyperplasia (CH), manifested as a limitation of mouth opening, is an increase in the volume of the mandibular coronoid process. Early diagnosis is of critical importance to restore proper mandibular function.

Purpose: The purpose of this case report and literature review is to illuminate the diagnosis criteria and management options for CH patients and increase the awareness of this condition among general dentists. **Methods:** Medical history and clinical examination were performed by trained practitioners in Orofacial Pain from the Herman Ostrow School of Dentistry. Differential diagnosis includes Myofascial Pain, Arthralgia, Disc Dislocation and Coronoid Hyperplasia. **Results:** The radiological characteristics suggest coronoid hyperplasia where the coronoid process appears elongated superiorly. This case also has clinical findings of bilateral myofascial pain and mild arthralgia. The treatment plan included CBCT imaging to verify coronoid hyperplasia diagnosis and develop a treatment plan. Patient education was provided with myofascial pain protocol to decrease overall inflammation and perception of oral pain, including self-care, jaw posture, soft diet, and thermal therapy. **Conclusions:** Coronoid process hyperplasia is a rare condition with the potential to cause severe limitation of mandibular opening by creating an anatomic mechanical obstacle to opening in the posterior portion of the maxilla or zygomatic arch. The literature review for CH determined a summary of management options, including the borderline criteria where cases can be managed conservatively, and

when they should be referred for surgery. Early diagnosis, leading to treatment is important to minimize skeletal deformity, restore mandibular movement and prevent compromise in function.

Poster #63

Title: FAM120A-PTPN3 variations in neuroblastoma: Implications for poor prognosis and relapse

Authors: Andres Stucky, Lingli Tu, Xuelian Chen and Jiang F. Zhong

Faculty advisor: Jiang F Zhong

Neuroblastoma (NB), the most common tumor in infants, presents unpredictability of relapse which remains the greatest clinical challenge. Up to date, molecular risk factors are less known. In this study, six NB patients who had both primary tumors and relapse samples were enrolled. A cohort analysis of genetic profiles revealed 40 potential mutations of relapse, including FAM120A and PTPN3. Mutation distribution and expression profiling in a larger population with 127 NB patients showed FAM120A mutation rate was 32.3% and PTPN3 was 52.8%. Both had significant impact on Overall survival (OS) by Kaplan-Meier analysis. The median OS (mOS) with or without FAM120A mutation was 1527±214 days and 2300±139 days, respectively ($p = 0.000$). mOS with or without PTPN3 mutation was 1822±163 days and 2285±179 days, respectively ($p = 0.037$). Additionally, mOS in group lacking both mutations (42/127) was 2555±196 days, much higher than 1857±153 days, in those who had only one (62/127), or 1391±266 days, in those who had both (23/127). Furthermore, the most prevalent mutation site on FAM120A was at Chr.9:93543407 (61.0%) and PTPN3 at Chr.9:109457194 (61.2%). Variants at Chr.9:93543407 had more significant impact on OS compared to other FAM120A-mutation sites subpopulation ($p =$

0.01). Expression of FAM120A was significantly down-regulated in the FAM120A-mutation subpopulation compared to non-mutated ($p = 0.01$). Ingenuity pathway analysis (IPA) indicated their possible interactions that may have an additive effect through TRIM25, MYC and VIRMA. Taken together, variations in FAM120A and PTPN3 interact in neuroblastoma resulting in poor prognosis and cancer relapse.

Poster #64

Title: Effect of PRMT4 deletion in cardiomyocytes

Authors: Siqi Tao and Jian Xu

Faculty advisor: Jian Xu

Background: Protein arginine methyltransferase 4 (PRMT4) is type I PRMTs, which can catalyze the formation of both monomethylarginine and asymmetrical dimethylarginine. PRMT4 participates in a wide variety of cellular processes. The recent publication demonstrates that PRMT4 overexpression is related to cardiomyocyte apoptosis. Cardiomyocytes constitute the majority of the heart by mass and have been shown to be major contributors to contractile dysfunction. However, the effect of PRMT4 deletion in cardiac function remains undefined. **Purpose:** We aimed to investigate the effect of PRMT4 deletion in cardiomyocytes. **Methods:** In the present study, we knocked out PRMT4 with Cre/loxP system in cardiomyocyte, which confirmed by western blot. Echocardiogram was applied to detect cardiac function. To explore the structural changes of heart, the hearts were weighted and sections were stained with H&E, lectin and picro-sirius red stains. The cardiomyocyte cross-sectional area and fibrosis area were quantified. RNAseq will be performed to investigate the change of the regulatory pathways. **Results:** Inflammatory cell infiltration and the rupture of myocardial cells that have lost their normal ordered structure can be identified in the PRMT4 deletion groups. **Conclusion:** Deletion

of PRMT4 in cardiomyocytes causes heart dysfunction.

Poster #65

Title: Role of Cardiac Fibroblasts in Modulating Angiogenesis during Cardiac Injury

Authors: Aesha Upadhyay, Ji-ang Qian and Jian Xu

Faculty advisor: Jian Xu

Background: Cardiovascular Disease is the leading global cause of death where 1 out of every 3 individuals die of heart failure. In response to cardiac injury or stress, the cardiac muscle cells undergo hypertrophy, and this pathological cell growth is not always backed up by the proportional increase in angiogenesis. The lack of vascularization exacerbates pathological remodeling and contractile dysfunction and accelerates the progression to heart failure. Cardiac fibroblasts are responsible for providing support and maintaining the structure of the heart tissue by secreting extracellular matrix proteins. These resident fibroblasts become activated and convert into myofibroblasts during the wound repair process. **Purpose:** This project focuses on understanding the role of resident and activated fibroblasts in modulating angiogenesis during cardiac injury. I will be using in vivo and in vitro models to investigate this question. **Methods:** Isoproterenol osmotic-pump implants are used to induce left ventricular hypertrophy in transgenic mice. In this disease model, Diphtheria Toxin A is expressed in periostin expressing myofibroblasts using the tamoxifen inducible Cre system. The cardiac tissue is harvested 14 days post-surgery, sectioned and stained for fibrosis, hypertrophy and vessel density. Fibrin gel bead assay is used as a 3D co-culture system to compare the efficiency of angiogenesis by endothelial cells (HUVEC) in presence of fibroblasts and myofibroblasts in vitro. Fibroblasts are activated to myofibroblasts using 10 ng/ml TGF β . **Results:** Cardiac

vessel density was significantly improved in isoproterenol subjected mice where myofibroblasts were ablated. **Conclusion:** Myofibroblasts are responsible for downregulating the angiogenesis process during cardiac injury.

DENTISTRY/ CCMB POSTDOCTORAL FELLOWS

Poster #66

Title: An evolutionarily conserved helix mediates ameloblastin-cell interaction

Authors: Jingtian Su, Rucha Arun Bapat, Gayathri Visakan and Janet Moradian-Oldak

Faculty advisor: Janet Moradian-Oldak

While it is known that enamel has a distinct set of ECM proteins, enamel cell-matrix adhesion has thus far remained enigmatic. Here, we examined the hypothesis that ameloblastin (Ambn) mediates cell-matrix adhesion by binding to ameloblast cell membranes through an amphipathic helix-forming (AH) motif. We applied high-resolution confocal microscopy to LS8, ALC and NIH3T3 cells to demonstrate Ambn adhesion to cell surfaces. We also showed co-localization between Ambn and ameloblast membrane surfaces in mouse mandibular tissues. Using a series of Ambn-derived peptides and Ambn variants, we showed that Ambn binds to cell membranes through a motif within the sequence encoded by exon 5. Using peptides derived from the N- or C-terminus of this sequence, and Ambn variants that lacked, or had a disrupted AH motif, we revealed that the AH motif located at the N-terminus of the sequence is involved in cell-Ambn adhesion. Sequence analysis revealed that this highly conserved AH motif is absent from other enamel ma-

trix proteins including amelogenin, enamelin, and amelotin. Collectively, these data suggest that Ambn binds to cell surface membrane via a helix forming motif and further improve understanding of enamel-cell matrix adhesion.

Poster #67

Title: A RAB39b-PI3K-mTOR pathway dependent dysregulation of cortical development leading to macrocephaly/autism phenotypes

Authors: Wei Zhang, Li Ma, Mei Yang, Qiang Shao, Jian Xu, Zhipeng Lu, Zhen Zhao, Rong Chen, Yang Chai and Jian-Fu Chen

Faculty advisor: Jian-Fu Chen

Dysregulation of early neurodevelopment is implicated in macrocephaly/autism disorders. However, the mechanism underlying this dysregulation, particularly in human cells, remains poorly understood. Mutations in the small GTPase gene RAB39b are associated with X-linked macrocephaly, autism spectrum disorder (ASD), and intellectual disability. The *in vivo* roles of RAB39b in the brain remain unknown. We generated Rab39b knockout (KO) mice and found that they exhibited cortical neurogenesis impairment, macrocephaly, and hallmark ASD behaviors, which resembled patient phenotypes. We also produced mutant human cerebral organoids that were substantially enlarged due to the over-proliferation and impaired differentiation of neural progenitor cells (NPCs), which resemble neurodevelopmental deficits in KO mice. Mechanistic studies reveal that RAB39b interacts with PI3K components and its deletion promotes PI3K-AKT-mTOR signaling in NPCs of mouse cortex and cerebral organoids. The mTOR activity is robustly enhanced in mutant outer radial glia cells (oRGs), a subtype of NPCs barely detectable in rodents but abundant in human brains. Inhibition of AKT signaling rescued enlarged organoid sizes and NPC over-proliferation caused by RAB39b

mutations. Therefore, RAB39b mutation promotes PI3K-AKT-mTOR activity and alters cortical neurogenesis, leading to macrocephaly and autistic-like behaviors. Our studies provide new insights into neurodevelopmental dysregulation and common pathways associated with ASD across species.

Poster #68

Title: Lhx6 is required for mouse root patterning

Authors: Jinzhi He, Jifan Feng, Tingwei Guo, Yuan Yuan and Yang Chai

Faculty advisor: Yang Chai

Background: Mammalian tooth development has long served as a model for studying basic questions of developmental biology. Crown development has been intensively explored. However, the regulation of root development, especially root number determination, is largely unknown. **Purpose:** To investigate the potential roles of Lhx6 in the development of the furcation, a structure that controls the root number. **Methods:** Mouse lines used in the present study included Lhx6-CreER, ROSA26loxP-STOP-loxP-tdTomato, Gli1-LacZ, and Gli1-CreER. MicroCT, HE staining, immunofluorescence, RNAscope and bulk-RNAseq were used. **Results:** Lhx6, an *in vivo* marker for a subpopulation of Gli1+ progenitor cells, is consistently and exclusively expressed in the apical dental mesenchyme. Lineage tracing showed that Lhx6+ cells mainly contributed to odontoblasts, alveolar osteoblasts, and periodontal ligament cells closely associated with root furcation development. Loss of Lhx6 resulted in a lack of furcation formation as well as root number defects in the molars but left the crown unaffected. Moreover, Lhx6 mutation compromised mesenchymal proliferation via increasing cell cycle inhibitor Cdkn1c, as well as disrupting odontogenic differentiation of dental mesenchyme by via increasing Wnt antagonist Sfrp2, thereby downregulating Wnt/

beta catenin signaling. **Conclusion:** Mesenchymal Lhx6 is a key regulator for root furcation formation and root number determination. Our study highlights the importance of dental mesenchyme regulation in root patterning and development, and it has important implications for tooth root regeneration.

Poster #69

Title: TGF- β signaling regulates soft palate development via mediating cell-cell interaction

Authors: Jifan Feng, Xia Han, Yuan Yuan, Courtney Cho, Jing Bi, Eva Janečková and Yang Chai

Faculty advisor: Yang Chai

Background: Coordinated movements of the soft palate and pharyngeal muscles are crucial for speech, swallowing, breathing, and hearing. Since cranial neural crest (CNC)-derived cells are in close contact with myogenic cells in multiple craniofacial myogenic sites, we hypothesized that CNC-derived cells regulate soft palate myogenesis through tissue-tissue interaction. **Purpose:** The aim of this study is to understand molecular mechanisms controlling soft palate muscle formation for better repair of soft palate defects. **Methods:** *Osr2-Cre;Alk5^{fl/fl}* mice were generated to specifically target the TGF- β signaling pathway in CNC-derived cells in the soft palate. Single-cell RNA sequencing analysis was performed to compare cell-type specific gene expression profiles in E14.5 *Osr2-Cre;Alk5^{fl/fl}* and control soft palates. **Results:** TGF- β signaling is specifically activated in CNC-derived cells surrounding myogenic cells in the developing soft palate. Loss of TGF- β signaling in the these CNC-derived cells in *Osr2-Cre;Alk5^{fl/fl}* mice leads to defective soft palate formation including disrupted soft palatal myogenesis. Single-cell analysis further identified significantly altered cell type composition in CNC-derived cells in the E14.5 *Osr2-Cre;Alk5^{fl/fl}* mouse soft

palate, particularly a reduction of Tbx15+ cell clusters which express Fgf18. RNAscope expression confirmed that Tbx15+Fgf18+ CNC-derived cells are in close contact with myogenic cells *in vivo*, and that this population is reduced in the absence of Tgf- β signaling in *Osr2-Cre;Alk5^{fl/fl}* mice. **Conclusions:** Specific activation of the TGF- β signaling pathway in CNC-derived cells in close proximity to myogenic cells may determine the fate of these CNC-derived cells and instruct them to produce key signaling molecules to regulate soft palate muscle formation.

Poster #70

Title: Mapping mouse molar development at single-cell resolution

Authors: Junjun Jing, Yuan Yuan, Jifan Feng and Yang Chai

Faculty advisor: Yang Chai

Background: Understanding the heterogeneity of cell populations in a particular organ can provide information about the mechanisms regulating the physiological function of the organ. The heterogeneity of odontogenic cell populations during molar development is unknown. **Purpose:** We aim to identify heterogeneity among odontogenic cell populations during molar development and elucidate their differentiation trajectories. **Methods:** Molars of wildtype mice at E16.5, PN3.5 and PN14.5 were dissected and homogenized into single-cell suspension. Single-cell RNA sequencing was performed with a Nextseq500 system and the reads were aligned with Cell Ranger. We used Seurat package implemented in R to identify major cell types and differentiation trajectories. Immunostaining, RNAscope and lineage tracing analyses were performed to validate the gene expression profiles. **Results:** We have revealed several new cell types in the mesenchyme and epithelium of mouse molars. Our results showed that there are distinct cellular domains within the mouse molar during development. We found that IGF sig-

naling is one of the most highly enriched signaling pathways in molar development, which has previously been unappreciated. Interestingly, we found that loss of Igf signaling leads to shorter root with compromised periodontal tissue formation. Surprisingly, our data suggested that Ki67+ fast-cycling cells at PN3.5 may serve as stem cells contributing to root complex formation. **Conclusions:** Our study provides comprehensive information about the heterogeneity and differentiation of dental cell populations in mouse molars and may lead to new strategies for tooth regeneration in the future.

Poster #71

Title: Real-time monitoring of osteomyelitis pathogen treated with novel bisphosphonate-fluoroquinolone antimicrobials

Authors: Parish P. Sedghizadeh, Esmat Sodagar, Natalia Tjokro, Shutting Sun, Adam F. Junka, Philip Cherian, Jeffrey Neighbors, R. Graham G. Russell, Charles E. McKenna and Frank H. Ebetino

Faculty advisor: Parish Sedghizadeh

Background: Staphylococcus aureus is a predominant cause of biofilm-associated infections such as osteomyelitis which is a limb- and life-threatening orthopedic infection, and extremely challenging to treat clinically. We have been designing and testing novel bone-targeting antibiotic drugs utilizing conjugation chemistry with bisphosphonates (BPs). BPs bind to hydroxyapatite (HA) matrix, the main component in bone, via strong dentate bonds. Because of this pharmacological property, BPs are extensively utilized to treat bone diseases. We designed, synthesized, and tested novel BP-fluoroquinolone conjugates for activity against Staphylococcus aureus biofilms. **Purpose:** The aim of this work was to use the rapid, reproducible and accurate technology "real-time cell analyzer" for screening and comparing the anti-biofilm ability of our new designed pharmacologically inert bis-

phosphonates (BPs) against bacterial biofilm. **Methods:** By using impedance measurements in microtitre plates with gold electrodes we have assessed the antibiotic effects of new synthesized BP-antibiotic conjugates on bacterial biofilm growth in real time. **Results:** Results show that real-time biofilm analysis can be a promising tool to evaluate antibiotic susceptibility and efficacy in biofilm-mediated infections clinically and also the novel conjugates designed and tested in this study has great antibiotic efficacy in comparison to the non-conjugated antibiotics in osteomyelitis preventative and eradication experiments in vitro. **Conclusions:** This class of conjugates using BP drugs as biochemical vectors for the delivery of antibiotic agents to bone could represent an advantageous approach to the treatment of osteomyelitis because it improves bone pharmacokinetics while minimizing systemic exposure.

Poster #72

Title: Antagonistic interaction between Kdm6b and Ezh2 regulates H3K27me3 during palatogenesis

Authors: Tingwei Guo, Jifan Feng, Xia Han, Jinzhi He, Junjun Jing and Yang Chai

Faculty advisor: Yang Chai

Background: Cleft palate is a common birth defect caused by failure of palatal shelf fusion. Defects in the palate adversely affect speech, swallowing, breathing, and hearing. Many genetic mutations associated with cleft palate have been identified, but little is known about the role of epigenetic regulation during palatal development. In this study, we used a transgenic mouse model to investigate the function of Kdm6b, an H3K27me3 demethylase, during palatogenesis. **Methods:** *Wnt1-Cre;Kdm6b^{fl/fl}* mice were generated to knock out *Kdm6b* from cranial neural crest (CNC)-derived cells. Immunohistochemistry, in situ hybridization (RNAscope), and

single-cell RNA-seq were used to reveal molecular mechanisms of Kdm6b involved in palatogenesis. **Results:** RNAscope showed that Kdm6b is broadly expressed in the craniofacial region. Loss of Kdm6b from CNC-derived cells caused complete cleft palate in *Wnt1-Cre;Kdm6b^{fl/fl}* mice. Reduction of Cyclin D1, a critical protein for cell cycle regulation, results in decreased cell proliferation in *Wnt1-Cre;Kdm6b^{fl/fl}* mice. Cell death was not affected. Kdm6b knockout also enriched H3K27me3 in the palatal mesenchyme. Through analyzing gene expression profiles, we found that expression of Bmp4 and Bmpr1a were decreased in *Wnt1-Cre;Kdm6b^{fl/fl}* mice, resulting in the reduction of pSmad1/5/9-positive cells. Expression of Runx2, a downstream target of BMP signaling, was also decreased in *Wnt1-Cre;Kdm6b^{fl/fl}* mice. Knocking out one allele of methyl transferase Ezh2 in mutant mice successfully rescued the cleft palate phenotype of *Wnt1-Cre;Kdm6b^{fl/fl}*. **Conclusion:** Our study highlights the importance of epigenetic regulation in palate development. Mesenchymal Kdm6b and Ezh2 play a critical role in regulating H3K27me3 during palatogenesis.

Poster #73

Title: Gli1 marks osteogenic progenitors for condylar bone formation in mandible

Authors: Jie Lei, Shuo Chen, Junjun Jing, Thach-Vu Ho, Zachary Ceniceris and Yang Chai

Faculty advisor: Yang Chai

Background: The mandibular condyle of the temporomandibular joint (TMJ) plays an important role in our daily life and its development initiates during later stage of embryonic development and continues into adulthood. The condyle also serves as a growth center for our face and undergoes constant remodeling. Osteoblastogenesis occurs throughout life during mandibular con-

dyle growth and homeostasis. Recent studies have shown that Gli1+ cells produce osteoblasts in femur, skull, and vertebrae. However, it is not clear where are the osteogenic progenitors for supporting mandibular condyle growth and homeostasis in adult. **Purpose:** To investigate the role of Gli1+ cells in mandibular condyle growth and homeostasis. **Methods:** We generated *Gli1-CreERT2;Tdtomato* mice for cell lineage tracing, in which Gli1+ cells and their progenies can be labeled by TdTomato fluorescence following induction. We also generated *Gli1-CreERT2;DTA-GFP* mice for genetic ablation of Gli1+ cells to assess their contribution to bone mass. The mice were euthanized at different stages after induction at neonatal and juvenile stages, respectively. MicroCT, HE staining, and immunofluorescence staining were conducted for analysis. **Results:** Gli1-lineage cells within the subchondral bone progressively expressed Runx2 and Osx, identifying them as osteogenic progenitors. Three-dimensional reconstruction of MicroCT images revealed the condyle was notably decreased in size in the DTA mice. **Conclusions:** Gli1+ cells are osteogenic progenitors contributing to the subchondral bone formation of the mandibular condyle during growth and homeostasis. Further studies are warranted to investigate the important role of Gli1+ cells in TMJ diseases such as osteoarthritis.

Poster #74

Title: Runx2 maintains the mouse incisor mesenchymal stem cell niche

Authors: Shuo Chen, Junjun Jing and Yang Chai

Faculty advisor: Yang Chai

Background: The mouse incisor is an excellent model for studying mesenchymal stem cells (MSCs). Previously, we found that quiescent Gli1+ cells near the neurovascular bundle are typical MSCs. Recently, we identified Runx2

expression in Gli1+ cells using single-cell RNA-sequence analysis. However, the function of Runx2 in regulating the fate of MSCs in adult mouse incisors is still unknown. **Purpose:** To investigate the role of Runx2 in maintaining tissue homeostasis and regulating the incisor MSC niche. **Methods:** We generated *Gli1-CreERT2;Runx2^{fl/fl}* mice, in which Runx2 is lost in the Gli1+ lineage. The mice were euthanized 1, 2, or 4 weeks after induction. The mandibles were collected and fixed. MicroCT, H&E staining, and immunofluorescence staining were carried out for analysis. **Results:** The number of transit-amplifying cells (TACs) decreased significantly while there were no apparent changes in apoptosis detected by TUNEL assay 1 week after induction in the mutant mice. The expression of dentin sialophosphoprotein (Dspp) was shifted to an earlier stage. Gli1+ stem cells decreased significantly 2 weeks after induction, which may result from a lack of feedback from TACs. RNA-seq data showed that *Igfbp3* was downregulated in the mutant mice, which was confirmed by RNA-scope. Further, immunofluorescence showed that p-Igf1r was downregulated in the mutant mice, suggesting the IGF signaling pathway was downregulated. **Conclusion:** Loss of Runx2 in Gli1+ cells affects the IGF signaling pathway, which regulates TAC proliferation as well as differentiation.

Poster #75

Title: Mandibular Distraction Osteogenesis: Treatment of OSA and Facial Balance

Authors: Allen Huang, Alice Liu, Jordan Wlodarczyk, Mark Urata and Jeffrey Hammoudeh

Faculty advisor: Jeffrey Hammoudeh

Purpose: Mandibular distraction osteogenesis (MDO) is highly effective in treating upper airway obstruction secondary to micrognathia in infants. The purpose of this study is to evaluate the long-term effica-

cy of MDO on treating infants with OSA as well as post-operative facial balance after initial over-distraction. **Methods:** Records of OSA infants with micrognathia who underwent MDO from 1995 to 2019 were reviewed. Pre and post-operative AHI, oxygen requirements, clinical photographs, and existing co-morbidities were analyzed. **Results:** 82 patients met inclusion criteria. The mean age at distraction was 63.32 ± 71.40 days. Average distraction rate was 1.73 mm/day to a mean distance of 27.51 mm. Preoperative PSG demonstrated a mean AHI of 34.06 ± 33.48 with lowest oxygen desaturation and mean oxygen requirement of 80% and 0.63L, respectively. Compared to preoperative findings, the first postoperative PSG demonstrated a decreased AHI to 5.76 ($p < 0.0001$), oxygen desaturation of 85.81%, and mean O₂ requirement of 0.26L ($p = 0.027$). A PSG at the last follow-up showed a decrease in AHI to 2.40 ($p = 0.016$), oxygen desaturation to 86.06%, and O₂ requirement of 0.05L ($p = 0.045$). Immediate post-operative photos showed 84% of patients who were distracted to skeletal class III were no longer prognathic during their follow up visits. **Conclusion:** MDO is a predictable technique to treat OSA in infants. MDO decreases AHI, the amount of oxygen desaturation, and amount of supplemental oxygen. Over-distraction to skeletal class III can result in more balanced skeletal profiles and minimize the extent of maxillomandibular movements should orthognathic surgery be required.

Poster #76

Title: Mechanistic study of the PRMT1 and PARP1 pathways in cardiac injury mouse model

Authors: Balazs Murnyak, Jian Wu and Jian Xu

Faculty advisor: Jian Xu

Background: The activation of poly ADP-ribose polymerase 1 (PARP1) is a hallmark of oxidative stress-induced cellular injury. The depletion of the

cellular NAD⁺ and ATP pools leads to energetic failure and cell death. Earlier reports presented that pharmacological inhibition or genetic deficiency of PARP1 exerts protective effects in multiple mouse models of cardiac injury. Our previous results identified PRMT1 as an upstream regulator of PARP1 and further showed that cardiomyocyte-specific deletion of protein arginine methyltransferase 1 (PRMT1) improves heart functions in a mouse model cardiac injury; however, the underlying mechanism remains unclear. **Purpose:** In our study, we aim to determine the interplay between PRMT1 and PARP1 and assess the mechanism by which PRMT1 regulates PARP1 turnover. **Methods:** To confirm whether PARP1 and PRMT1 interact, we employ a combination of in vitro binding assays and recombinant proteins and cell-based analysis. To investigate the interplay between PRMT1 and PARP1 in cardiomyocytes after cardiac injury, we used an inducible cardiomyocyte-specific *Prmt1* deletion model *PRMT1^{fl/fl};Myh6-cre*. **Results:** We observed that the depletion of PRMT1 decreased PARP1 protein levels and asymmetric arginine dimethylation of PARP1. In our in vivo cardiac injury model, nuclear PARP1 expression was found in the cardiomyocytes, indicating injury-elicited induction of PARP1. PRMT1-specific deletion in cardiomyocytes results in reduced PARP1 protein expression, as well as decreased PARylation levels. **Conclusion:** Based on our results, we anticipate that PRMT1 and PARP1 depletion can improve the preservation of cardiac function in a cardiomyocyte injury mouse model.

Poster #77

Title: Runx2 Regulates Soft Palate Development through Patterning Neural Crest-derived Cells

Authors: Summer Xia Han, Jifan Feng, Tingwei Guo, Yuan Yuan, Thach-Vu Ho, Jing Bi, Brian Song, Jingyuan Li, Junjun Jing, Eva Janečková and

Yang Chai

Faculty advisor: Yang Chai

Background: The soft palate is crucial for essential physiological functions. Cranial neural crest (CNC) cells give rise to soft palate mesenchyme and guide craniofacial muscle development. **Purpose:** To investigate the regulatory mechanisms of soft palate development. **Methods:** We performed single-cell RNA-seq analysis of soft palate at E13.5-E15.5. Immunofluorescent staining and in situ hybridization were performed to analyze the expression patterns of specific genes. We generated *Osr2-Klcre;Runx2^{fl/fl}* mice to delete Runx2 in a subset of CNC-derived cells. We performed microCT, histology, and single-cell RNA-seq analysis to identify regulating mechanisms of Runx2 in soft palate development. **Results:** We demonstrated heterogeneity in the soft palate mesenchyme associated with distinct cell fates: perimysial, stromal and osteogenic lineages. Runx2 is closely associated with multiple subpopulations of CNC-derived mesenchyme, and loss of Runx2 in CNC-derived cells results in bone, palate and muscle defects in the soft palate of *Osr2-KlCre;Runx2^{fl/fl}* mice. We also revealed that loss of Runx2 leads to ectopic expression of Twist1 in perimysial CNC-derived cells and reduced expression of myogenic-associated genes in CNC-derived cells. Haploinsufficiency of Twist1 in *Osr2-KlCre;Runx2^{fl/fl}* rescues multiple soft palate defects associated with loss of Runx2. **Conclusion:** Our results suggest that Runx2 may regulate the differentiation and fate decisions of distinct CNC-derived cell populations that play diverse roles during soft palate development. Thus, Runx2 may fine-tune soft palate morphogenesis via orchestrating CNC-derived mesenchymal cell fate, particularly of the perimysial and palatal stromal cells, in a spatiotemporally specific manner through tissue-tissue interactions.

Poster #78

Title: Ameloblastin reversibly and competitively binds amelogenin and phospholipid membranes

Authors: Natalie C. Kegulian, Jingtian Su and Janet Moradian-Oldak

Faculty advisor: Janet Moradian-Oldak

Background: To form tooth enamel, epithelial cells called ameloblasts secrete enamel matrix proteins (EMPs), predominantly amelogenin (Amel) and ameloblastin (Ambn), with calcium phosphate into the enamel matrix space. Previously, we found Ambn to interact with both Amel and phospholipid membranes via a region encoded by its fifth exon. These *in vitro* interactions are relevant *in vivo*, as Amel-Ambn double knock-out mice have more than the sum of the enamel defects in single knock-outs, underscoring the importance of Ambn-Amel interactions; also, Ambn has signaling and adhesion functions, which require membrane interactions. **Purpose:** To define binding dynamics between Ambn and Amel and between Ambn and phospholipid membranes and probe the structure of the binding region of Ambn during these interactions. **Methods:** We used AB2, a peptide representing Ambn exon 5, several cysteine mutants thereof wherein the mutated site is tagged with a paramagnetic spin label, and full-length Ambn. We applied multiple biophysical methods including fluorescence, circular dichroism (CD), and electron paramagnetic resonance (EPR) to measure their interactions with liposomes and with full-length Amel. **Results:** We found that liposomes and Amel compete for binding to Ambn. Tryptophan fluorescence shifts show liposomes taking up AB2 and preventing its interaction with Amel, and vice versa. EPR showed α -helix formation in AB2 upon interaction. **Conclusion:** Our *in vitro* data suggest that Ambn exon 5 toggles between binding membranes and binding Amel *in vivo*, with implications toward its complex role in enamel formation.

Poster #79

Title: Reversing behavior abnormalities in mice exposed to maternal ZIKV infection

Authors: Li Ma and Jianfu Chen

Faculty advisor: Jianfu Chen

Background: Zika virus (ZIKV) infection during pregnancy is correlated with increased frequency of neurodevelopmental disorders, which may cause several behavioural abnormalities in the offspring. The related mechanism at the cellular and circuit level remains largely unknown. **Purpose:** We aimed to define the mechanism on how social memory deficit developed in mice prenatally exposed to ZIKV-induced maternal immune activation (MIA). **Method:** Mouse model was generated by intravenously injecting ZIKV to pregnant dams at E12.5 and the behaviour phenotypes were characterized at 6-8 weeks old offspring. Neural activities were measured using whole-cell patch electrophysiology system, calcium live imaging and neural activity marker c-fos immunostaining, and which could be orchestrated by using chemogenetic and optogenetic system aiming to reverse the social memory deficit. **Results:** We found that ZIKV infection during pregnancy, in a dose-dependent manner, resulted in autistic-like behaviours, including impaired social memory in the offspring. ZIKV affected progeny mice exhibited an abnormal increase in excitability of pyramidal neurons in the medial prefrontal cortex (mPFC), which may be caused by the combined effect of reduced inhibitory neuron activities and elevated excitatory control from ventral hippocampus neurons. Inhibiting neuron activity from the ventral hippocampus (vHIP) to mPFC was sufficient to rescue the social memory deficits of ZIKV-affected offspring. **Conclusion:** Our results identified neuronal ensemble and long-range impairment driving social memory deficits in mouse offspring following maternal ZIKV infection.

Poster #80

Title: Arid1a Regulates Mouse Molar Root Development

Authors: Jiahui Du, Junjun Jing and Yang Chai

Faculty advisor: Yang Chai

Background: The formation of a functional molar root involves reciprocal interactions between dental epithelium and mesenchyme and offers an attractive model for investigating organogenesis. Arid1a is a subunit of SWI/SNF complex, which can regulate chromatin accessibility at loci critical for specific organogenesis and modulate commitment and differentiation of stem/progenitor cells. How Arid1a regulates tooth root development remains unknown. **Purpose:** To identify the role of Arid1a in the development of mouse molar roots. **Methods:** We examined the expression pattern of Arid1a in mouse molars by immunostaining. We generated *Gli1-CreER;Arid1a^{fl/fl}* mutant mice and performed CT imaging and H&E staining to investigate the function of Arid1a in the tooth root progenitor cells during development. RNAscope and immunostaining were performed to examine odontoblast differentiation, periodontal ligament formation, and cell cycle-associated markers. ATAC-Seq and RNA-Seq were performed to investigate the changes in chromatin accessibility and gene expression. **Results:** Arid1a is strongly expressed in the dental epithelium and mesenchyme during tooth root formation. Loss of Arid1a in tooth root progenitor cells leads to a shortened root and delayed tooth eruption, abnormal root dentin and periodontal tissue. This indicates a critical role for Arid1a in the proliferation and differentiation of tooth root progenitor cells. Mechanistically, our data show that the functions of Arid1a are mainly mediated by modulating chromatin accessibility at the mitotic genes for tooth root development. **Conclusions:** Our findings highlight the importance of Arid1a in tooth root development and will have important implications for strategies for

tooth regeneration in the future.

Poster #81

Title: Ror2-mediated non-canonical Wnt signaling regulates tooth root development

Authors: Yuanyuan Ma, Junjun Jing, Quan Wen, Jingyuan Li and Yang Chai

Faculty advisor: Yang Chai

Background: Mammalian tooth root development begins after the completion of crown formation. Canonical Wnt/ β -catenin signaling plays important roles in tooth root formation. Wnt5a ligand, one component of the non-canonical Wnt signaling pathway, is associated with tooth development. However, its function and that of Ror2 during root formation remain unknown. **Purpose:** To investigate the roles of mesenchyme- and epithelium-derived non-canonical Wnt signaling in tooth root development. **Methods:** We generated epithelial- and/or mesenchymal-specific loss-of-function of non-canonical Wnt signaling using *K14-rtTA;Teto-cre;Ror2^{fl/fl}* and *Osr2-cre;Ror2^{fl/fl}* mice. Doxycycline rodent diet was administered to *K14-rtTA;Teto-cre;Ror2^{fl/fl}* every day from E14.5. **Results:** Epithelial-specific deletion of Ror2 at E14.5 had no effects on root formation. However, loss of Ror2 in dental mesenchyme led to retarded root elongation at PN9.5 and severely shortened roots at 3 weeks after kidney capsule transplantation of tooth germ from *Osr2-cre;Ror2^{fl/fl}* mice at PN5.5. At PN3.5 and PN5.5, cell proliferation in the apical region was significantly decreased in *Osr2-cre;Ror2^{fl/fl}* mice. However, there was no change in cell apoptosis. At PN3.5, the expression of Nfatc4 and Cdk2 was decreased in *Osr2-cre;Ror2^{fl/fl}* mice. At PN5.5, Axin2 expression was also decreased in the apical region. **Conclusion:** Loss of Ror2 in dental mesenchyme decreases cell proliferation via Nfatc4 in the apical region and inhibits postnatal root development. The inhibition of canonical Wnt signaling pathway may also contribute.

Poster #82

Title: Cranial Suture Regeneration and Cognitive Improvement in a Craniosynostosis Model

Authors: Mengfei Yu, Li Ma, Yuan Yuan, Jianfu Chen and Yang Chai

Faculty advisor: Yang Chai

Background: Craniosynostosis is characterized by premature cranial suture fusion, which can cause severe outcomes including abnormal growth of the skull, increased intracranial pressure, retarded brain development and impaired neurocognitive function. Surgery is the only treatment option currently. After surgery, calvarial bones may re-fuse and require repeated operations to relieve the constriction on the brain.

Purpose: The present study was designed to establish the rationale for employing biomaterials together with stem cells for cranial suture regeneration to provide a novel treatment for patients with craniosynostosis.

Methods: In this study, we took advantage of the *Twist1^{+/-}* mouse model, which shows increased intracranial pressure and dysmorphology of the craniofacial skeletal complex as the result of cranial suture fusion. Following the removal of the fused coronal suture in *Twist1^{+/-}* mice, we delivered Gli1+ cells mixed with a GelMa-based biomaterial into the resulting gap between the calvarial bones. We then evaluated the regenerated suture and neurocognitive function after 6 months.

Results: Our results showed that there is a specific correlation between the diminished number of Gli1+ cells in a suture and its premature fusion in both humans and *Twist1^{+/-}* mice. Significantly, we showed that Gli1+ MSCs combined with modified GelMa were able to support coronal suture regeneration. The newly regenerated suture partially alleviated the calvarial deformity typically seen in *Twist1^{+/-}* mice. In parallel, we found for the first time that craniosynostosis of the coronal suture is associated with neurocognitive defects in *Twist1^{+/-}* mice. Finally, regeneration of the coronal suture

generated improvement in neurocognitive behavior in these *Twist1^{+/-}* mice. **Conclusions:** Modified GelMa loaded with Gli1+ cells is an ideal biomaterial to support functional suture regeneration in *Twist1^{+/-}* mice, and this study lays the groundwork for a novel regenerative treatment for patients with craniosynostosis.

Poster #83

Title: Canonical Wnt signaling is essential for soft palate muscle development

Authors: Eva Janečková, Xia Han, Jifan Feng and Yang Chai

Faculty advisor: Yang Chai

Background: Major physiological functions such as swallowing, breathing, hearing, and speech are governed by the soft palate, and these are disrupted when cleft palate occurs. The surgical correction of cleft soft palate is very challenging as it involves extensive repair of musculature.

Purpose: The objective of our investigation is to analyze canonical Wnt signaling during embryonic soft palate development, and its role in regulation the interactions between cranial neural crest (CNC) and mesoderm-derived cells during this process as well as the regulation of cilia development.

Methods: Histologic analyses of *Osr2-Cre;β-catenin^{fl/fl}* conditional knockout mice, *β-catenin^{fl/fl}* control mice, and LacZ reporter mice; immunofluorescence; RNAscope; RNA-sequencing; and Partek Flow analysis. **Results:** Wnt signaling is abundantly active in the soft palatal region in embryonic stages, and conditional deletion of *β-catenin* specifically in the CNC-derived mesenchyme using the *Osr2-Cre* model produced severe changes in the mesoderm-derived soft palatal muscles. RNAseq analysis performed on control and mutant soft palatal shelves revealed differentially expressed genes associated with muscle development (*Myod1*, *Myf5*, *Myh7*), cell junction, cytoskeleton (*Chd15*, *Des*, *Acta1*) and cilia (*Dnah9*, *Dnaic1*, *Ak7*, *Drc1*). These genes represent

potential downstream targets of canonical Wnt signaling in the soft palate and their functions in this system need to be further tested. **Conclusion:** Our results highlight the importance of Wnt signaling during soft palate development and suggest the significance of the interaction between the CNC-derived mesenchyme and myogenic cells. Our results also highlight the role of cilia in soft palate muscle formation, which deserves further analysis and more attention.

Poster #84

Title: Cardiac Fibroblast-Specific Deletion of PRMT1 Protects against Ventricular Dysfunction

Authors: Jiang Qian, Aesha Upadhyay, Prerna Sehgal and Jian Xu

Faculty advisor: Jian Xu

Background: Cardiac fibroblast and its programmed activation into myofibroblasts are critical regulators in myocardial extracellular matrix (ECM) homeostasis. Our lab recently identified protein arginine methyltransferase 1 (PRMT1) as a new in vitro regulatory mechanism for cardiac fibroblasts differentiate to myofibroblasts. **Purpose:** To investigate the in vivo roles of PRMT1 in cardiac fibrosis during the pathophysiological process of heart failure.

Methods: We performed TAC or sham surgery on fibroblast-specific *Prmt1* knockout mice (*PnMCM/+;Prmt1^{fllox}/fllox;R26R^{YFP/YFP}*) and *Prmt1^{fllox}/fllox;R26R^{YFP/YFP}* controls. **Results:** We observed that deletion of PRMT1 in cardiac fibroblasts prevented the myofibroblasts differentiation, decreased cardiac fibrosis, increased the vessel density and preserved the ventricular function after 8w of TAC. In addition, PRMT1 inhibitor MS023 successfully prevented chronic heart dysfunction in wild type TAC-mice. Interestingly, we found that PRMT1 regulated cardiac fibroblasts fate probably through methylation of histones in cardiac remodeling. **Conclusion:** *Prmt1* would

be a promising therapeutic target in treating heart failure.

Poster #85

Title: YAP1/CDH6/OCT4 interactions mediating differentiation resistance of mesenchymal stem cells participate in solid tumor development

Authors: Andres Stucky, Lan Sun, Li Gao, Shengwen Calvin Li, Xuelian Chen, Jun Luo, Tiffany H. Park, Jin Cai, Xi Zhang and Jiang F. Zhong

Faculty advisor: Jlang Zhong

Despite the promising clinical benefits, some detrimental effects of mesenchymal stem cells (MSCs) have been reported, in some cases including tumorigenicity. The reason for this remains unclear. YAP1 (Yes-associated protein 1) and its associated pathway play a key role in organ development, but their potential involvement in MSC tumorigenicity remains inconclusive. Therefore, we conducted this study to investigate YAP1-related signaling networks in both MSCs and solid tumors. Using single cell isolation and RNAseq, here we investigated a set of differentiation resistant (RD) mesenchymal stem cells that could be partly responsible for their pro-tumorigenic properties. We found 1780 genes were significantly differentially expressed in both PO and DO compared to the DR MSCs. Importantly, CDH6, OCT4 and YAP1 expression were significantly up-regulated within the DR MSCs in comparison to PO or DO. A survey of 57 clinical cohorts revealed a high correlation among the expression of CDH6, YAP1 and OCT4. Additionally, YAP1 was expressed in only a fraction of cancer cells as well as DR MSCs. YAP1 inhibition down-regulated solid tumor cell lines viability and gradually inhibited YAP1 nuclear localization with doses of 2, 5 and 10μM verteporfin, while reducing the transcriptions of CDH6 and OCT4 as well. We conclude that CDH6/YAP1/OCT4 interactions mediating DR MSCs participation in the

development of solid tumors.

Poster #86

Title: Oral bacteria promote KSHV lytic replication

Authors: Shu Zhang, Zhiqiang Qin, Jiang F. Zhong, Casey Chen and Pinghui Feng

Faculty advisor: Pinghui Feng

The human oral cavity contains highly diverse microbial communities including bacteria, fungi and viruses. Human herpesviruses are ubiquitous pathogens and the oral cavity is conducive for the replication, dissemination and pathogenesis of human herpesviruses. In AIDS patients, the compromised immune system allows dysregulated growth of microbial pathogens, resulting in the severe development of oral inflammation and diseases. For example, Kaposi's Sarcoma-Associated Herpesvirus (KSHV), the etiological agent of Kaposi's sarcoma, causes oral KS in AIDS patients, indicative of severe immune compromising by HIV infection. Mounting evidence indicated a high KSHV viral load correlated with ongoing bacterial infection in the oral cavity, suggesting a mutual stimulation between bacteria and KSHV. However, the mechanism by which oral bacteria may promote KSHV lytic replication is poorly understood. In this study, we performed 16S RNA sequencing on saliva samples of AIDS-KS patients. A correlation analysis identified a panel of oral residential bacteria and uncommon ones that paralleled with KSHV viral load. Using KSHV lytic replication in HOK after de novo infection, we found *Neisseria gonorrhoeae* and *Aggregatibacter Actinomyces* significantly increased KSHV lytic replication in HOK cells. Increased KSHV lytic replication was evidenced by elevated levels of mRNA and proteins of viral lytic genes. Ongoing work is geared to dissect the molecular mechanism by which *Neisseria* and *Aggregatibacter* stimulate KSHV lytic replication, focusing on the host machinery. Findings from our study will shed light

on the molecular detail of polymicrobial interaction in oral cavity and provide an innovative strategy to treat diseases associated with polymicrobial infections.

Poster #87

Title: *Aggregatibacter actinomycetemcomitans* Core and Accessory Genes: What Do They Do?

Authors: Natalia O. Tjokro, Weerayuth Kittichotirat, Roger E. Bumgarner and Casey Chen

Faculty advisor: Casey Chen

Background: Gram negative periodontal pathogen *Aggregatibacter actinomycetemcomitans* (Aa) exhibits a high degree of genetic variation among strains. Each Aa genome consists of core genes found in all strains, and accessory genes (14-23% of the genome) found in some but not all strains. Accessory genes are further grouped into genomic islands and non-island accessory genes. The functions of accessory genes remain to be elucidated. We hypothesized that accessory genes confer critical functions in vivo that allow Aa to survive during unfavorable conditions. **Purpose:** To investigate the expression patterns of Aa accessory and core genes in distinct growth conditions. **Methods:** Aa strain D7S-1 was grown in 4 different conditions: as planktonic cells or biofilms in an enriched medium, and as biofilms in two nutrient-poor media RPMI and Keratinocyte medium. The levels of transcripts were determined by RNA sequencing. **Results:** The expression patterns of the island and non-island accessory genes were similar, with median expression values ~2 fold lower than core genes. Both island and non-island accessory genes were activated to a greater extent than core genes in nutrient-poor media. Notably, several virulence genes of Aa were activated in nutrient-limited conditions. **Conclusion:** Aa accessory and core gene pools exhibit distinct expression profiles. Activation of genomic islands, non-island accessory genes

and selected core genes may help Aa cope with the stress of nutrients limitation and to acquire nutrients via eliciting host inflammatory response, probably a novel strategy of Aa to survive in its host.

Poster #88

Title: Alk5-mediated signaling is critical for mouse tooth root development

Authors: Jing Bi, Jifan Feng and Yang Chai

Faculty advisor: Yang Chai

Background: The TGF- β superfamily plays a crucial role in regulating the fate of cranial neural crest cells during craniofacial development, including embryonic tooth development. However, it remains unclear whether TGF- β signaling pathway is also involved in tooth development in the postnatal stages during which the tooth root forms. **Purpose:** The aim of this project is to investigate whether and how TGF- β signaling pathway regulates mouse tooth root development. **Methods:** pSmad2 antibody staining was used to detect TGF- β activity in postnatal root development. *Gli1Cre-ER;Alk5^{fl/fl}* and *Gli1Cre-ER;Tgfb2^{fl/fl}* mice were generated to test the functional requirement for TGF- β type I and type II receptors in root development. **Results:** TGF- β signaling activity, indicated by pSmad2 expression, is detectable in the dental mesenchyme at all stages of postnatal root development. Loss of Alk5 in the molar mesenchyme before root formation leads to shortened roots in *Gli1-CreER;Alk5^{fl/fl}* mice, with thinner root dentin and defective root odontoblast differentiation. In contrast, ablating *Tgfb2* in the molar mesenchyme at the same stage has no significant effect on *Gli1Cre-ER;Tgfb2^{fl/fl}* mouse root development, suggesting that TGF- β type I and type II receptors may play different roles during tooth root development. **Conclusion:** Our results demonstrate that a signaling pathway mediated by Alk5, the TGF- β type I receptor,

plays an important role in root development.

Poster #89

Title: Fgfr2 and Notch2 work synergistically to regulate the development of the craniofacial complex

Authors: Ryan R. Roberts, Lauren Bobzin and Amy E. Merrill

Faculty advisor: Amy Merrill

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. Our recent study has shown that Fgfr2 patterns cell fate at the tendon-bone attachment site of the jaw. The attachment site is morphologically graded from tendinous to osseous and arises from bipotent progenitors that co-express *Scleraxis* (*Scx*) and *Sox9* (*Scx⁺/Sox9⁺*). Fgfr2 upstream of Notch signaling was shown to maintain the *Scx⁺/Sox9⁺* progenitor cells. The neural crest specific loss of Fgfr2 (*Wnt1-Cre;Fgfr2^{fl/fl}*), reduced Notch signaling, and increased *Sox9⁺* cells at the expense of the *Scx⁺/Sox9⁺* progenitors. To further investigate the Fgfr2 and Notch signaling mechanism, neural crest conditional double knockout mice (*Wnt1-Cre;Fgfr2^{fl/fl};Notch2^{fl/fl}*) were generated. The double mutants exhibit patency of the frontal suture and fusion of the coronal suture that is more severe than either single mutant (*Wnt1-Cre;Fgfr2^{fl/fl}* or *Wnt1-Cre;Notch2^{fl/fl}*). The condyle and angular processes of the jaw also exhibit a more severe phenotype than the single mutants, having shorter processes with large, ectopic bony spicules. This data suggests that both Fgfr2 and Notch2 work synergistically to regulate the development of sutures and jaw processes.

Poster #90

Title: Runx2 maintains the mouse incisor mesenchymal stem cell niche

Authors: Shuo Chen, Junjun Jing and Yang Chai

Faculty advisor: Yang Chai

Background: The mouse incisor is an excellent model for studying mesenchymal stem cells (MSCs). Previously, we found that quiescent Gli1+ cells near the neurovascular bundle are typical MSCs. Recently, we identified Runx2 expression in Gli1+ cells using single-cell RNA-sequence analysis. However, the function of Runx2 in regulating the fate of MSCs in adult mouse incisors is still unknown. **Purpose:** To investigate the role of Runx2 in maintaining tissue homeostasis and regulating the incisor MSC niche. **Methods:** We generated *Gli1-CreERT2;Runx2^{fl/fl}* mice, in which Runx2 is lost in the Gli1+ lineage. The mice were euthanized 1, 2, or 4 weeks after induction. The mandibles were collected and fixed. MicroCT, H&E staining, and immunofluorescence staining were carried out for analysis. **Results:** The number of transit-amplifying cells (TACs) decreased significantly while there were no apparent changes in apoptosis detected by TUNEL assay 1 week after induction in the mutant mice. The expression of dentin sialophosphoprotein (Dsp) was shifted to an earlier stage. Gli1+ stem cells decreased significantly 2 weeks after induction, which may result from a lack of feedback from TACs. RNA-seq data showed that *Igf1r* was downregulated in the mutant mice, which was confirmed by RNA-scope. Further, immunofluorescence showed that p-Igf1r was downregulated in the mutant mice, suggesting the IGF signaling pathway was downregulated. **Conclusion:** Loss of Runx2 in Gli1+ cells affects the IGF signaling pathway, which regulates TAC proliferation as well as differentiation.

**UNDERGRADUATE
AND DDS
BASIC
SCIENCES**

Poster #91

Title: Illustration of Temporal-Spatial Specific Expressed Genes in the Soft Palate

Authors: Summer Han, Avrita Brar, Patricia Asuncion and Yang Chai

Faculty advisor: Yang Chai

Background: Orofacial clefting is one of the most common congenital craniofacial abnormalities in humans. Previously we have identified multiple specific transcription factors that are involved in regulating soft palate development. Disruption of these genes leads to soft palate clefting along with palatal muscle defects, resulting in oropharyngeal deficiency. **Purpose:** Illustrations of the spatiotemporally specific gene expression patterns during soft palate development allow for improved understanding of soft palate development and the regulating genetic network. This helps in the development of new treatments and preventive strategies for cleft palate. **Methods:** Gene expression patterns were analyzed by using immunofluorescence staining, RNAscope in situ hybridization and imaging. The expression pattern of each gene was analyzed in all soft palate muscles from E13.5 - E15.5, to understand the activation of specific genes associated with the development of the soft palate. Templates were created to represent the soft palate structure at different developmental stages, and the spatial specific gene expression patterns were illustrated on these templates. **Results:** We observed the dynamic expression and change of Runx2, Twist1, Hic1, Foxf2 and Sp7 during development of the soft palate. Combined with our previous single-cell RNA-seq data, we mapped the expression of those lineage-specific transcription factors to specific anatomical locations in the soft palate. **Conclusion:** These visual representations illustrate spatiotemporally specific expression patterns during soft palate development. They enable further investigation of the underlying mechanisms that regulate soft palate devel-

opment, which will eventually lead to novel clinical treatment strategies for soft palate regeneration.

Poster #92

Title: Aggregatibacter actinomycetemcomitans Phenotypes in a Polymicrobial Biofilm Model

Authors: Christie Shen, Yuting Tiffany Chang, Natalia Tjokro and Casey Chen

Faculty advisor: Casey Chen

Background: Gram negative Aggregatibacter actinomycetemcomitans (Aa) is a periodontal pathogen and a member of the polymicrobial biofilms (dental plaque). Past studies of Aa were often done in pure cultures. However, the behaviors of single-species biofilms are dramatically different from those of multi-species biofilms. The phenotypes of Aa in a polymicrobial setting remain poorly understood. **Purpose:** To develop a polymicrobial biofilm model to examine Aa behaviors and interactions with other oral bacterial species. **Methods:** Cells from four species of interest (Aa D7S-1, Streptococcus gordonii, Porphyromonas gingivalis, and Filifactor alocis) were evaluated for their growth in TSBYE, BHI, SHI, or RPMI media. Single or multi-species biofilms of Aa and other species, quantified through crystal violet staining and total CFU counts, will then be used to evaluate the synergistic or antagonistic relationship between the study species. **Results:** Our preliminary data showed that BHI medium to be optimal in sustaining the survival of the four oral strains, while poor bacterial survival was observed when RPMI, a nutrient-limited medium, was used. **Conclusion:** The phenotypes of Aa in pure cultures and polymicrobial biofilm are expected to be different. The interactions between the many organisms in a polymicrobial biofilm may affect the phenotypes of Aa in dental plaque.

**UNDERGRADUATE
AND DDS
CLINICAL
SCIENCES**

Poster #93

Title: Temporomandibular Joint "Mice": Report of Two Cases of Osteochondritis Dissecans

Authors: Melika Haghighi, Tarun Mundluru, Fariba Farrokhi and Mariela Padilla

Faculty advisor: Mariela Padilla

Background: Osteochondritis Dissecans is an idiopathic bone anomaly, where a bone fragment is detached and remodeling is present beneath the surface of the lesion. One of the radiological characteristics in the TMJ is the presence of loose bodies on the condylar heads, and the patient might report pain, joint sounds, and limitation of oral movements. **Purpose:** To present two cases of Osteochondritis Dissecans, identified by panoramic imaging. The first case is a 66-year-old female, and the condition was an incidental finding. The second case is a 55-year-old female; with jaw clicking and mild pain. Both patients signed the authorization to use protected health information for education and instruction form. **Methods:** Medical history and clinical examination were performed by calibrated practitioners in Orofacial Pain from the Herman Ostrow School of Dentistry. Differential diagnosis includes Osteophytes and Osteochondritis Dissecans. **Results:** The radiological characteristics are consistent with Osteochondritis Dissecans, stage 4, where the fragments are not attached to the bone surface. Both cases have findings suggesting localized myalgia, and the second exhibits mild capsulitis. No functional limitations were identified. The treatment plan included CBCT imaging and monitor evolution. Phys-

ical therapy was included for the muscle pain and anti-inflammatories for the capsulitis. **Conclusion:** Selecting a conservative approach is a logical alternative when the patient does not have functional limitation or pain, and close monitoring allows identifying the need to pursue further treatment. The use of panoramic imaging as a preliminary diagnostic approach is useful to identify the presence of "joint mice".

Poster #94

Title: Creation of Intuitive Categories for Root Shapes Using Card Sort

Authors: Daniel Chee and Glenn Sameshima

Faculty advisor: Dr. Glenn Sameshima

Background: Apical root resorption (ARR) in orthodontics is caused by high pressure on roots during treatment. Tooth morphology has a significant effect on the amount of ARR, as irregular shapes can cause pressure points. Morphologic categories of 2-D representations of teeth already exist, but despite the increasing usage of CBCT imaging, 3-D categories have yet to be created. **Purpose:** The goal of this study is to create intuitive categories of 3-D root shapes that can be consistently used by orthodontists to study ARR. **Methods:** A two-stage card sort method was used to create intuitive categories of 3-D root shapes and subsequently test whether those groups could be consistently sorted into. **Results:** Following stage one of the card sort, the two categories that participants sorted into the most were "straight vs. curved" and "tapered vs. non-tapered". In stage two of the card sort process, participants showed most agreement on whether roots were "straight" or "curved", but less agreement on if roots were "tapered" or "non tapered". **Conclusion:** The card sort technique has shown that the most intuitive categories for root shapes are "curved" and "straight", with "tapered" and "non-tapered" being a second-

ary category. These categories can be used for future studies regarding root shape and ARR.

Poster #95

Title: Opioid usage prevalence in older adults in a dental population

Authors: Maile Osborne, Reyes Enciso, Roseann Mulligan and Piedad Suarez-Durall

Faculty advisor: Piedad Suarez-Durall

Background: Dentists are among the leading prescribers of opioids behind physicians. Over 40% of older adults have chronic pain that is usually treated with opioids, risking drug dependence. The American Dental Association released a policy encouraging dentists to be cognizant of opioids harmful effects and potential abuse. **Purpose:** This study examined opioid prevalence in patients >65 years within a dental school clinic and the type of opioid profile/strength. These results were compared to prescription opioid usage reported in the National Health and Nutrition Examination Survey (NHANES). **Methods:** Self-reported opioid use was extracted from records of patients >65 years visiting the dental school general clinic (GDC) in 2012 and 2017. This data was compared to NHANES (2011-2012). (IRB #UP-12-00232). **Results:** There was a significant increase in opioid usage prevalence at the GDC in 2017 (6.6%) as compared to 2012 (4.5%; $p < 0.01$) with an increase in females ($p < .05$) and adults 75-84yr ($p < .05$). Of those adults taking at least one opioid, the proportion of patients reporting hydrocodone decreased from 2012 to 2017 (63.0% to 43.8%; $p < .01$) while those reporting tramadol increased (23.5% to 38.0%; $p < .05$). The majority of patients who used one opioid reported taking a morphine-equivalent opioid with a higher proportion in 2012 GDC (61.7%) as compared to NHANES (39.4%; $p < .01$). **Conclusion:** Despite public health strategies advocating against overprescribing, the

prevalence of opioids in older adults at Ostrow increased significantly in 2017 as compared to 2012. The data suggests a need for diligence in training students/dentists in selecting non-opioid analgesics for pain.

Poster #96

Title: Does Procalcitonin have a role in determining odontogenic infection severity

Authors: Khal Liam Mancini, Felix Kyle Yip and Kyle Joseph Shiffler

Faculty advisor: Felix Kyle Yip

Background: In order to gauge the severity of an odontogenic infection, many clinician rely on a combination of physical exam findings, vital signs, and laboratory results. No standardized protocol is widely accepted in how to interpret these findings, nor how to definitively treat. Most clinical decisions are based off of previous experience and physician preference. Procalcitonin, an inflammatory marker, is widely used in the management of pneumonia and sepsis, and many clinician have interest in determining its utility in monitoring other types of infections. **Purpose:** The purpose of this study is to identify predictive factor for infection severity and investigate the possible utility of Procalcitonin in odontogenic infections. **Methods:** An IRB approved retrospective study (#HS-18-00715) evaluated 53 patients admitted to a county hospital for an odontogenic infection. Data involving medical comorbidities, presenting signs and symptoms, laboratory findings including Procalcitonin, radiographic imaging, antibiotic use, treatment in training students/dentists in selecting non-opioid analgesics for pain.

Poster #97

Title: Design and in vivo testing of a novel bisphosphonate-fluoroquinolone antibiotic conjugate chemisorbed to bone graft material for treatment of peri-implantitis

Authors: Henry Connor Yim, Ariella Glodowski, Parish Sedghizadeh, Neema Bakhshalian and Raffie Garabedian

Faculty advisor: Parish Sedghizadeh

Background: Despite medical advancements, bone infections continue to be difficult to treat, often requiring surgical debridement and long-term antibiotic therapy. High concentrations of these antibiotics are required at the site of the bone infection; however, due to pharmacokinetic parameters and the manner in which antibiotics are metabolized, bone absorption is difficult to achieve. **Purpose:** This study is a continuation of ongoing research which investigates a novel approach for the targeted delivery of antibiotics to treat jawbone infections. **Methods:** Our approach uses a biologically inert bisphosphonate conjugated to a potent fluoroquinolone antibiotic chemisorbed to bone graft substitute for treatment of peri-implant infection. Six canines (beagles/female) were used in a split mouth design. Mandibular premolars (# 2, 3 and 4) bilaterally were atraumatically extracted and the sites were allowed to heal for 3 months. Then dental implants were placed at each extraction site. Peri-implantitis will be induced in the next phase of the study using *Aggregatibacter actinomycetemcomitans* and *Porphyromonas gingivalis* dual-species biofilms inoculated on implant healing caps. Once peri-implantitis is established, treatment with our antimicrobial bone graft conjugate will be performed (and compared to controls treated with bone graft alone or antibiotic alone) following local debridement. **Results:** Results are pending. At study endpoint, we will analyze radiographic bone levels before and after treatment and also CFU counts to quantify microbial load and reduction in the various groups (treatments versus controls). **Conclusion:** Treatment of biofilm-mediated infectious bone diseases such as peri-implantitis remain challenging with no known cure, and often due to inadequate

delivery or release of antibiotics at infected osseous sites. The development of this novel conjugate aims to reduce the morbidity associated with jaw bone infections by providing a bone-targeted therapeutic.

Poster #98

Title: Dental expansion using a buccal Beta-Titanium By-pass Expander (BTBE)

Authors: Murilo Neves and Nirav Patel

Faculty advisor: Julio Gurgel

Background: In cases of maxillary atresia in adult patients, the use of protocols such as Hass and Hyrax fixed expanders, perform slow expansions with long maintenance of the appliance, as retainers of the results. The long-term use of these devices installed on the palate leads to greater patient discomfort in speaking, swallowing and hygiene. **Purpose:** With the purpose to reduce this discomfort, we propose the making of Beta-Titanium By-pass Expander (BTBE), bypassing buccal archwire, thereby not occupying the patient's palate. Therefore, the aim of this study is to describe a clinical case of dental expansion with BTBE. **Method:** The wire expander is made with .032", extending across the upper arch contour buccal, from molar to molar on the opposite side, providing distribution of force throughout the entire dental arch extension. **Results:** At the end of treatment, it was established ideal occlusion with normal function and esthetic, demonstrating the effectiveness to maxillary atresia correction using BTBE. **Conclusion:** Comparing BTBE with the traditional slow expansion palatal devices, dental expansion was achieved similarly. However, BTBE presented less discomfort for the patient, which may encourage the long term use of this device.

Poster #99

Title: An investigation of education models of local dental

anesthesia instruction

Authors: James Tom, Eumi Choi and Kristeen Chu

Faculty advisor: James Tom

Background: Traditionally, in dental education, the established method of teaching local anesthesia administration to pre-doctoral dental students has involved student-to-student injections. However, administering anesthesia involves risks and potential for tissue damage. Complications such as hematoma, trismus, and paresthesia can be caused by any intraoral injection technique. The once common practice of peer-to-peer injections is now being challenged in light of ethics. Administering intraoral injections for no therapeutic purpose and without a process of informed consent specifically violates the notions of autonomy and nonmaleficence. The need for a process of informed consent and a choice to receive injections for students currently enrolled in a dental program is the focus of a revised curriculum of dental local anesthesia education. **Purpose:** The purpose of this study is to collect preliminary data for a longitudinal, retrospective study. The long-term goal is to evaluate the need for any paradigm shifts in the dental community to implement a consistent process of informed consent starting in the pre-doctoral level and to emphasize and stimulate a thorough discussion of risks versus benefit. **Methods:** Two surveys were developed: one for faculty and one for students. Surveys consisted of a series of ordinal questions and participants were asked to rate on a scale of one to five ranging from whether they strongly disagreed or strongly agreed with a certain belief. These surveys were distributed to the clinical faculty dentists and Class of 2020 dental students at the Herman Ostrow School of Dentistry. **Results:** Currently in process. **Conclusion:** Not yet completed.

Poster #100

Title: The role of lipid metabo-

lism in craniofacial development

Authors: Courtney Cho, Jifan Feng and Yang Chai

Faculty advisor: Yang Chai

Background: Lipid metabolism is crucial for various biological processes and has recently been found to be associated with craniofacial development. Specifically, a deficiency in the enzyme 7-dehydrocholesterol reductase (DHCR7) results in Smith-Lemli-Opitz syndrome, characterized by abnormal cholesterol metabolism, which can lead to craniofacial defects such as microcephaly and cleft palate, among other traits. The SREBP-2 transcription factor and its cleavage-activating protein SCAP are required for lipid synthesis and regulate DHCR7. Previous studies have shown that SREBP-2 and SCAP play an important role in chondrogenesis and embryo limb bud development in mice. Thus, we hypothesized that the SCAP/SREBP-2 signaling pathway is required for craniofacial development. **Purpose:** The aim of this study is to understand the mechanism of lipid metabolism in regulating craniofacial development. **Methods:** RNA scope analysis was used to detect expression levels of *Srebf2*, the encoding gene for *Srebp2*, and *Scap* in embryonic mouse craniofacial tissues. *Wnt-1Cre;Srebf2^{fl/fl}* mice were generated to target the SCAP/SREBP-2 pathway in cranial-neural-crest-derived cells during craniofacial development. The resulting craniofacial defects were analyzed at E12.5, E13.5, and E16.5. **Results:** *Srebf2* and *Scap* expression was extensive in the craniofacial tissues of E14.5 mice. Loss of the SCAP/SREBP-2 pathway in *Wnt-1Cre;Srebf2^{fl/fl}* mice led to craniofacial defects as early as E12.5. Histological analysis revealed various craniofacial defects in E13.5 and E16.5 *Wnt-1Cre;Srebf2^{fl/fl}* mice, including a shorter palatal shelf, smaller teeth, impaired mandibular bone formation, and disorganized tongue muscles. **Conclusion:**

The SCAP/SREBP2 signaling pathway is crucial for craniofacial development, and loss of the pathway leads to severe craniofacial malformations.

Poster #101

Title: Emergency Management of Traumatic Dental Injuries Among School Nurses

Authors: Chieh Tsai, Madison Tran, Parisa Moussavian and Stephanie Showing

Faculty advisor: Julie Jenks

Background: Dental trauma is an important problem which can affect children and adolescents. Falls, fights, and sport injuries are among the common causes of dental trauma in schools. The results from previously administered questionnaires to Pasadena and Long Beach school districts suggest that there is a need for routine follow-up training in the management of TDIs. **Purpose:** The purpose of this study is to assess the knowledge and ability of school nurses and health clerks in the Pasadena and Long Beach Unified School District to manage traumatic dental injuries (TDIs), specifically tooth avulsion, in school children, immediately after, 4-10 months after, and 1 year after a lecture in managing TDIs. **Methods:** A lecture on the management of TDIs was given to the participants by a pediatric dentist. A post training questionnaire was administered immediately, and 4-10 months after training session. A refresher lecture was given 1 year following the initial questionnaire, and a post-training questionnaire was administered immediately after the lecture. The questionnaire contains objective questions to measure the changes in participants' knowledge in the management of TDIs after the training. **Result:** After training in TDIs, results from the 1-year follow-up demonstrated improvement in knowledge of TDI management among health clerks and school nurses compared to the 4-10-months follow-up results. School nurses responded more accurately to questions on management of

traumatic dental injuries compared to health clerks. **Conclusion:** A routine follow-up training in the management of TDIs is necessary at school districts for better management of TDIs in school children.

Poster #102

Title: The first definitive case report of MRONJ associated with osimertinib

Authors: Saeed A. Bigdeli, Dennis L. Gorospe, Audrey Boros and Parish P. Sedghizadeh

Faculty advisor: Parish Sedghizadeh

Background: Medication-related osteonecrosis of the jaw (MRONJ) is a serious adverse effect of mainly anti-resorptive drugs used to treat osteoporosis and skeletal cancer, such as the bisphosphonates and denosumab. Recently, one potential case of MRONJ associated with an epidermal-growth-factor-receptor (EGFR) tyrosine kinase inhibitor (osimertinib) was reported; this case lacked histologic confirmation of MRONJ and ruling out metastatic disease and also did not meet the American Academy of Oral and Maxillofacial Surgery definition of MRONJ. **Purpose:** The purpose of this paper is to report the first definitive case of MRONJ associated with osimertinib. **Methods:** This is a case report of a 65-year-old male with stage IV non-small cell lung cancer who developed MRONJ a few months after extraction of a partially erupted left mandibular third molar. A few months after the extraction, the patient returned complaining of pain and swelling in the left posterior mandible. Clinical examination revealed ulcerated alveolar mucosa at the site with infection and an exophytic necrotic mass. CBCT imaging revealed a large lytic lesion of the left posterior mandible and ramus with central sequestrum-like formation. Surgical biopsy was performed, and histologic examination confirmed a diagnosis of osteonecrosis and no evidence of metastatic cancer. **Results:** Osimertinib is a third

generation EGFR tyrosine kinase inhibitor. This case documents MRONJ occurrence in a patient following use of this medication. **Conclusion:** Given the growing use of targeted therapies for cancer treatment, dentists should be familiar with the potential for MRONJ in susceptible patients with concomitant risk factors such as tooth extraction.

BIOKINESIOLOGY & PHYSICAL THERAPY PHD CANDIDATES

Poster #103

Title: The Footprint of Pain: Motor Adaptations in Recurrent Back Pain

Authors: Hai-Jung Steffi Shih and Kornelia Kulig

Faculty advisor: Kornelia Kulig

Background: Low back pain (LBP) has become the leading cause of global disability largely due to its chronic and recurrent nature. Current knowledge of the underlying biopsychosocial mechanisms is yet inadequate to explain or predict symptoms. Motor adaptations to pain may play a role in recurrence, but it is unclear whether this adaptation persists beyond symptom duration. **Purpose:** To investigate trunk coordination in and out of an episode of recurrent LBP. **Methods:** Twenty participants with recurrent low back pain (tested in and out of pain) and twenty matched back-healthy controls participated in this study. Testing consisted of motion capture and electromyography while participants walked on a treadmill with 5 prescribed step widths. Thorax and pelvis angular excursions, kinematic coordination, and muscle activity of the longissimus were calculated. **Results:** Only reporting frontal plane data for brevity. Regardless of their pain status, individuals with recurrent LBP had

lower thorax angular excursions than controls. They also had more pelvis-only and less thorax-only patterns, as well as less bilateral longissimus co-contraction. When in active pain, individuals with recurrent LBP reduced trunk angular excursions, and increased in-phase and reduced anti-phase patterns to a similar level as the controls. When in remission, individuals with recurrent LBP had smaller changes in peak longissimus activation in response to different step widths than controls. **Conclusion:** Alterations in trunk control existed regardless of pain status in individuals with recurrent LBP. Active pain induced a more similar, but not identical, trunk control pattern as the back-healthy controls.

Poster #104

Title: Periodized Resistance Training Improves Fluid Cognition in Older Adults

Authors: Timothy R. Macaulay, Judy Pa, Jason J. Kutch, Christianne J. Lane, Dominique Duncan, Lirong Yan and E. Todd Schroeder

Faculty advisor: E. Todd Schroeder

Background: Resistance training (RT) is a promising strategy to slow or reverse fluid cognitive decline during aging. While cognitive improvements have been demonstrated after 6-12 months of traditional RT, the use of advanced strength and conditioning principles may expedite these benefits. **Purpose:** The purpose of this study was to determine whether 12-weeks of periodized RT improves fluid cognition in healthy older adults 60-80 years of age. **Methods:** Twenty participants (14 female) completed this study. There were 3 testing sessions (T1, T2, T3) during which standard measures were administered for fluid and crystallized cognition. During the 12-week control period (T1-T2), participants were encouraged to continue their normal activities of daily living, but were not monitored. During the 12-week RT intervention (T2-T3), participants

performed the periodized program 3 days per week in the Clinical Exercise Research Center, supervised by an exercise specialist. **Results:** After the control period, there were no significant changes in any of the tests. Reliability was moderate to good for fluid measures (ICC = 0.57 – 0.81), and good to excellent for crystallized measures (ICC = 0.89 – 0.93). Fluid cognition composite scores significantly increased from pre- to post-intervention ($8.2 \pm 6.1\%$, $p < 0.01$, $d = 1.27$), but crystallized cognition composite scores did not ($d = -0.34$). Performance on all of the individual fluid instruments, except episodic memory, significantly improved after training, including executive function, attention, working memory, and processing speed. **Conclusion:** 12-weeks of periodized resistance training improves fluid cognition in older adults.

Poster #105

Title: Conflict in monitoring, not planning, spatially asymmetric discrete bilateral reaches

Authors: Rini Varghese, James E. Gordon, Robert L. Sainburg and Carolee Winstein

Faculty advisor: Carolee Winstein

Sensorimotor interference in planning, executing and correcting bilateral movements especially arise when the hands are required to accomplish two independent or disparate goals. We investigated sensorimotor interference during performance of a planar reaching task, in which the two hands moved to two visually cued targets at separate distances (spatially asymmetric, B-A). Control conditions consisted of same-size movements performed unimanually with each limb (U) and bimanually to symmetric targets (B-S). Online visual feedback was withheld. Task instructions emphasized speed and accuracy but not interlimb synchrony. Velocity profiles were bell shaped with a single clearly defined peak. Contrary to our hypothesis, movement times

were not significantly correlated between the limbs and did not differ between U and B-A conditions but were faster for the B-S condition (by ~50ms). A closer examination of MT revealed that the absolute and relative time-after-peak velocity to movement end (i.e., the deceleration phase) was significantly prolonged for the limb reaching the farther target in the B-A condition compared to the U and B-S conditions of the same size. Absolute time-to-peak velocity, however, did not differ between the conditions. Final position errors were slightly smaller for the left hand for both bimanual conditions, but this improved accuracy was neither associated with directional errors at peak velocity (i.e., straighter paths) nor to the prolonged deceleration phase (i.e., feedback-based adjustments). The prolonged deceleration observed for the far target in the B-A condition might suggest a conflict in monitoring two spatially asymmetric movements rather than in planning or executing such movements.

Poster #106

Title: Quantifying Infant Exploratory Learning

Authors: Jeongah "Jane" Kim, Sungwoo Park, Linda Fetters and Barbara Sargent

Faculty advisor: Barbara Sargent

Background: Exploration is considered essential to infant learning, but few studies have quantified infant exploratory learning during a task. **Purpose:** The purpose of this study was to quantify how infants explored space with their feet while learning to activate an infant kick-activated mobile. **Methods:** Data were analyzed from fifteen 4-month-old infants who participated in a 10-min scaffolded mobile task on 2-3 consecutive days. All infants had learned that their vertical leg movements above a systematically increased threshold height activated the mobile. Three variables were analyzed: variance of vertical and horizontal foot positions,

exploration volume, and exploration density around and above the threshold height that activated the mobile. **Results:** The infants who learned the task increased their task-specific exploration (vertical variance of foot positions, exploration volume, and exploration density) across days. However, the non-task-specific exploration (horizontal variance of foot positions) did not change. **Conclusion:** Quantifying exploration may provide critical insights into how learning emerges in early infancy and, in turn, enable researchers to more systematically describe, interpret, and support learning. This study has implications for researchers describing, interpreting, and supporting infant exploratory learning.

Poster #107

Title: How does increasing loading demands effect knee mechanics after ACLr?

Authors: Sara Almansouri, Anushree Dighe, William Barclay and Susan Sigward

Faculty advisor: Susan Sigward

Background: Following anterior cruciate ligament reconstruction (ACLR) individuals exhibit decrease knee extensor moments (KextMmt) by altering heel rocker mechanics. Altered mechanics persists long term suggesting current gait training protocols are ineffective. **Purpose:** Determine effect of increasing gait speed on knee mechanics during early recovery of ACLr. **Methods:** Individuals following ACLr (16.9 ± 2.4 weeks; age: 23.0 ± 2.4 , sex: 4F; n=6) walked on treadmill at self-selected speed (SS), SS+25%, and SS+50% (3minutes/speed). KextMmt and heel rocker mechanics variables: flexion excursion (Flex), shank angular velocity (AngVel), posterior (pGRF) and vertical (vGRF) ground reaction forces were calculated during loading response of last 30 seconds. Symmetry indices were calculated as peak knee extensor moment SX/peak knee extensor moment NSX. Effect sizes (ES) estimated

magnitude of mean difference between speeds. Pearson correlation coefficient determined relationships between KextMmt with heel rocker variables. **Results:** KextMmt increased at SS+25% (ES-SX:0.29, ES-NSX:0.62), and SS+50% (ES-SX:0.86, ES-NSX:1.79). Knee loading symmetry decreased at SS+25% (ES:0.48), and SS+50% (ES:2.08). **Conclusion:** Surgical limb KextMmt increases with speed were accompanied by worse between limb symmetry and no changes in underlying heel rocker mechanics suggesting those in early rehab may not tolerate increased loading demands.

Poster #108

Title: Intrinsic properties of motoneurons facilitate generation of stable force output

Authors: Akira Nagamori and Francisco J. Valero-Cuevas

Faculty advisor: Francisco Valero-Cuevas

The ability to sustain smooth force output for a long period of time is critical to maintain a stable posture. Such an ability depends on stable recruitment of motor units where they maintain their activity with low discharge variability. The activity of motor units during voluntary contraction in human displays hysteresis in their recruitment (lower synaptic current required to de-recruit than recruit a motor unit). This hysteresis is likely due to intrinsic properties of motoneurons, which promote their self-sustained discharges. Therefore, we hypothesized that this hysteresis would prevent sporadic motor unit discharges and enhance smooth force output (i.e., smaller force variability). The purpose of this study was to quantify the effect of hysteresis in motor unit discharges on force variability. We developed a computational model of a population of 120 motor units. We simulated the hysteresis in motor unit discharges as an additional synaptic current into motor units upon their recruitment. Addition of hysteresis in motor unit recruitment increased the discharge rate of

recruited motor units at a given synaptic input level and prevented sporadic discharges of near-threshold motor units that would have been recruited randomly by synaptic noise. This leads to a reduction in force variability. Intrinsic properties of motoneurons play a key role that enables generation of sustained, smooth force output. This finding is critical to understand the neurophysiological mechanisms for impaired postural control in aging and other clinical conditions.

Poster #109

Title: Associations between brain connectivity and locomotor learning in Parkinson's disease

Authors: Aram Kim, Jonas Kaplan, Sook-Lei Liew, Giselle Petzinger and James M. Finley

Faculty advisor: James M. Finley

Background: Communication between the basal ganglia and cortex is an important mediator of motor skill learning. The rate at which people acquire a motor skill is negatively correlated with the level of resting-state functional connectivity (rsFC) between the putamen and cortex, indicating that decreased connectivity may benefit motor skill acquisition. Early Parkinson's disease (PD) impairs dopaminergic projections to the putamen, and this impairment is partially alleviated by dopamine replacement therapy. However, dopamine replacement can cause excessive dopamine in the putamen, potentially contributing to increased connectivity with the dorsolateral prefrontal cortex (DLPFC) and deficits in motor skill acquisition. **Purpose:** Therefore, we hypothesized that the degree of rsFC between the putamen and DLPFC would be negatively correlated with skill acquisition rate. **Methods:** We obtained resting-state functional magnetic resonance imaging from 16 people with PD. We used a seed-to-seed analysis to estimate rsFC between the bilateral anterior putamen and DLPFC. Subsequently, participants practiced a skill

learning task while walking on a treadmill, where they were instructed to step over obstacles within a range defined by the experimenter. We estimated the skill acquisition rate using a state-space model. **Results:** Participants reduced their foot clearance error at a rate of 0.06 ± 0.07 m per obstacle. We also observed a trend toward a negative association between skill acquisition rate and rsFC between the anterior putamen and DLPFC ($r=-0.47$, $p=0.06$). **Conclusion:** These preliminary results suggest that a bias toward the reliance of explicit cognitive processes may interfere with error signal processing during motor skill acquisition.

Poster #110

Title: Exploring neuropsychological mechanisms of fear of falling

Authors: Alexander J. Garbin, Maxfield Munk, Marisol Dakan and Beth E. Fisher

Faculty advisor: Beth E. Fisher

Background: Older adults with fear of falling experience a greater likelihood of future falls in part due to the employment of a stiffening strategy. While this biomechanical consequence is known, the underlying mechanisms are poorly understood. We propose two possible sources: adoption of an internal focus of attention (IFA) and concomitant reduction in cortical reciprocal inhibition (CRI). Together these may increase muscle co-contraction, thus resulting in the stiffening strategy and increased fall risk. **Purpose:** To first characterize the relationships between co-contraction and the proposed neuropsychological mechanisms (IFA and reduced CRI) in older adults with and without a fear of falling during standing. **Methods:** 2 older adult participants stood with a narrow-base-stance or single-limb-stance while being instructed to stand quietly with no focus instruction, an IFA, or external focus of attention. While standing, CRI was quantified via the combined use of

peripheral electrical stimulation and transcranial magnetic stimulation. Co-contraction index was measured via electromyography placed on the Soleus and Tibialis Anterior of the dominant limb. Participants' adopted focus of attention following each instruction was quantified via electroencephalography coherence. **Results:** In our participants, there was an association between IFA and greater co-contraction. The association between CRI and co-contraction differed based on standing condition with reduced CRI being associated with reduced co-contraction during narrow base stance and increased co-contraction during single-limb-stance. **Conclusion:** Our preliminary findings suggest that adoption of an IFA may be a source of co-contraction while the influence of cortical reciprocal inhibition may depend on standing task difficulty.

Poster #111

Title: Which Hip Extensor Strength Testing Position Enhances Gluteus-Maximus-to-Hamstrings Torque Ratio?

Authors: Jia Liu, Hsiang-Ling Teng, David M. Selkowitz, Skulpan Asavasopon and Christopher M. Powers

Faculty advisor: Christopher M Powers

Study Design: Controlled Laboratory Study; Cross-sectional
Background: Diminished gluteus maximus muscle strength has been proposed to be contributory to various lower extremity injuries. As such, it is of clinical importance to perform hip extensor strength testing in a position that biases torque contribution of the gluteus maximus relative to the other hip extensors (i.e. hamstrings). **Purpose:** To determine the relative torque contributions of the gluteus maximus and hamstring muscles in various hip extension strength testing positions. **Methods:** Young, healthy participants (7 females, 6 males) performed maximum isometric hip extension on a dynamometer in 4 different

positions that varied in terms of hip and knee flexion. Surface electromyography (EMG) was used to assess activation of gluteus maximus and hamstrings during the maximum isometric contractions. Normalized EMG data were used as an input to determine individual muscle torques using SIMM modeling software. The gluteus maximus/hamstring torque ratio was compared across the 4 positions using a one-way repeated-measures ANOVA. **Results:** The highest gluteus maximus torque occurred in positions where the hip was flexed to 45° while the highest hamstring torque occurred in positions in which the knee was fully extended. The gluteus maximus/hamstring torque ratio was highest at 0° of hip extension and 90° of knee flexion. **Conclusion:** Testing isometric hip extension strength at 0° of hip extension and 90° of knee flexion should be considered in order to bias torque production of the gluteus maximus relative to the hamstrings.

**BIOKINESIOLOGY
&
PHYSICAL
THERAPY
MS & PHD STUDENTS**

Poster #112

Title: Visual behavior during an infant contingency learning study

Authors: Marcelo R. Rosales, Isabel Reed, Jose Carlo Pulido, Nina S. Bradley, Maja J. Matarić and Beth A. Smith

Faculty advisor: Beth Smith

Background: Infant contingency learning in the mobile paradigm is defined as an increase in the amount of movement. However, an increase in movement could be driven by multiple variables; hence, current methods may misclassify non-learners as learners. Additional measures, such as anticipatory gazes directed toward the reinforcement (i.e. predictive gaze), may provide

information to better examine contingency learning in young infants. To explore this, we measured the timing of gazes directed at a robot to identify evidence of anticipatory behavior in a contingency learning study. **Methods:** Twelve infants (6-9 months) participated in a contingency learning task where movement of their right leg resulted in a robot kicking a ball. Head mounted eye-tracking was used to estimate the position of the infant's gaze during the task. Trained personnel, performing a frame-by-frame analysis, identified the onset of a predictive gaze each time the infant activated the robot. Predictive gaze was defined as a visual fixation on the robot 0-400ms prior to its activation. **Results:** Five of 12 infants had usable eye tracking data. Four infants were categorized as learners based on leg movement rate. Three of the 4 learners were able to visually anticipate the majority of the robot's kicks in a minute period. The remaining infants (1 learner, 1 non-learner) did not demonstrate predictive gaze. **Conclusion:** Overall, this study shows that the analysis of visual behavior can provide insight into infant learning. We will continue collecting data and determine best practices for including predictive gaze in the assessment of infant learning.

Poster #113

Title: Determinants of Hip Internal Rotation in Persons with Femoroacetabular Impingement

Authors: Jordan Cannon, Alexander E. Weber and Christopher M. Powers

Faculty advisor: Christopher Powers

Background: Symptomatic impingement in persons with femoroacetabular impingement syndrome (FAIS) results from premature abutment between the proximal femur and acetabular rim during activities that require significant hip flexion (i.e. squatting). Studies evaluating FAIS have reported peak shear stress and contact

pressures on the acetabular rim are greatest when the hip is flexed ($\geq 90^\circ$) and internally rotated. **Purpose:** To evaluate the influence of bony morphology and neuromuscular control on hip internal rotation excursion in persons with and without FAIS during a squat task. **Methods:** Four persons with confirmed FAIS and 3 individuals without FAIS have participated in this ongoing clinical study. Using data obtained from CT imaging, 3D pelvis models were reconstructed for each participant. Acetabular anteversion was measured as the transverse angle between the acetabular rim plane and the anterior pelvic plane. Lower extremity kinematics and surface electromyography (EMG) were collected while participants performed 5 constrained (feet parallel and pelvis width apart) maximal depth body-weight squats. EMG data from the adductor longus and gluteus maximus were integrated over the descent phase of the squat and a relative activation ratio was calculated (Add:GMax). Multiple regression was used to evaluate the influence of acetabular anteversion and Add:GMax on hip internal rotation excursion. **Results:** Greater acetabular anteversion and higher Add:GMax ratios were found to be associated with greater hip internal rotation excursion (multiple $R^2 = 0.40$). **Conclusion:** Results obtained thus far suggest that hip internal rotation excursion during squatting likely is the result of an interaction between bony structure and neuromuscular control.

Poster #114

Title: Quantity and Variability of Infant Leg Movement During Contingent Learning

Authors: Weiyang Deng, Marcelo Rosales, Barbara Sargent, José Carlos Pulido, Maja J. Matarić and Beth A. Smith

Faculty advisor: Beth Smith

Background: Movement acceleration is a critical parameter in motor control. However, it is still unknown how infants learn to control the acceleration

of their movements. Our objective is to determine whether infant learners (L) and non-learners (NL) show different quantity and/or variability of leg movement in a contingent learning paradigm. **Methods:** Nine infants (7-9-month-old) with typical development participated in the study. Their movements were monitored by accelerometers for a 2-minute baseline, 8-minute contingency, and 2-minute extinction period. Infants received reinforcement from the robot when their right leg peak accelerations were between 9-20 m/s^2 during the contingency period. Infants whose leg movement frequency within the acceleration band during the contingency period was 1.5 times greater than baseline were identified as learners. Quantity (1. general movement quantity; 2. proportion of movements within acceleration band compared to general movement quantity (Prop)) and variability of acceleration (1. nonlinear variability: sample entropy (SampEn); 2. linear variability: interquartile range (IQR)) of their leg movements during the contingency session were normalized to baseline. Peak performance was compared between learners and non-learners using Mann-Whitney tests. **Results:** Six out of nine infants were identified as learners. Compared to non-learners, learners demonstrated a higher quantity of general movement (median: L:2.2, NL:0.6, $p=0.04$), higher Prop (median: L:3.3, NL:0.6, $p=0.02$), higher non-linear variability (SampEn median: L:4.2, NL:1.1, $p=0.048$) and linear variability (IQR median: L:2.5, NL:1.0, $p=0.03$) during the contingency period. **Conclusion:** The results indicated both quantity and variability of movement may influence the learning process of adjusting leg acceleration control during infancy.

Poster #115

Title: Dance exertion alters feedforward mechanisms for lower extremity muscle recruitment

Authors: Christopher Laine, Hai-Jung Steffi Shih, Amanda

C. Yamaguchi and Kornelia Kulig

Faculty advisor: Kornelia Kulig

Background: Consequences of prolonged physical activity include consciously-driven and subcortically-based motor control modification. Experimental protocols featuring a repeated primary task complemented by secondary movements may elucidate changes in motor control that would typically accompany athletic occupations. Muscle activity prior to ground contact involves neural prediction of demands and allows insight into exertion-induced changes in the motor system's ability to prepare for ground contact. **Purpose:** The purpose of this study was to test the hypothesis that flight phase muscle recruitment patterns would be altered in dancers performing numerous rate-controlled sauté jumps. **Methods:** Surface EMG was collected on seven muscles of the preferred stance limb. The signals were band-pass filtered and rectified for analysis of pre-activation onset (lag between EMG onset and onset of measurable ground reaction force). The signals were then normalized by maximum voluntary isometric contraction for assessment of pre-activation amplitude. Changes over time were assessed via linear regression. **Results:** The results indicated a significant decrease in gastrocnemius and soleus EMG amplitude ($p < 0.05$) while semitendinosus amplitude increased significantly ($p < 0.001$). Gluteus maximus and vastus lateralis pre-activation onset occurred significantly earlier, indicating earlier onset relative to ground contact ($p < 0.05$). **Conclusion:** Continuous dance-specific activity affected feedforward signals that are typical of preparation for ground contact. Impaired ability for neural recruitment of muscles included reduced pre-activation amplitude in the primary ankle plantar flexors. Earlier pre-activation onset of the gluteus maximus and vastus lateralis indicates possible substitution of the proximal extensors for the ankle as the primary controllers.

Poster #116

Title: Repetitive Dental Hygienist Tasks Increase the Risk of Shoulder Pain

Authors: Daniel Awokuse, Federico Pozzi, Catarina Sousa, Hillary Plummer, Brittany Andrade, Naoko Kono, Wendy Mack, Shawn Roll and Lori Michener

Faculty advisor: Lori Michener

Background/Purpose: Repetitive job-related upper extremity tasks are thought to be a risk factor for developing musculoskeletal shoulder pain. Dental hygienists have repetitive job-related tasks and report a high incidence of shoulder pain. This study assessed the association of the incidence of shoulder pain and supraspinatus tendon morphology in dental hygienist (DH, at-risk group) and occupational therapist (OT, non-at-risk group) students. **Methods:** Shoulder pain was measured with a visual analog scale (VAS). Ultrasound images of supraspinatus thickness (cross-sectional and transverse views) and occupation ratio were collected at baseline and 12-months later. The minimal detectable change for the VAS was used to identify participants that developed shoulder pain at the 12-month evaluation. **Results:** Over 12 months, a greater proportion of DH developed shoulder pain compared to OT (22% vs. 6%, $p=0.03$); positive likelihood ratio= 1.8 (95%CI: 1.2, 2.7). At 12 months, greater supraspinatus thickness was related to greater VAS for shoulder pain ($r=0.29$; $p<0.01$). The DH-developed pain group had greater increase of supraspinatus cross-sectional thickness (1.0mm; 95%CI: 0.3, 1.6; $p<0.01$) and occupation ratio (8.4%; 95%CI: 1.7, 15.1; $p<0.01$) compared to the OT. **Conclusions:** DH students are at higher risk of developing shoulder pain after 12 months of academic training. Moreover, the development of shoulder pain is associated with an 18% thickening of the supraspinatus tendon. The supraspinatus presence in the subacromial space is also more prominent in the DH

group that developed shoulder pain. These morphological changes in the supraspinatus are compatible with signs of supraspinatus tendinopathy.

Poster #117

Title: Improved Fitness Following a 10-Week Golf Program for Older Adults

Authors: Jared Moore, K. Kanwar, H. Lee, R. Hawkes and George Salem

Faculty advisor: George Salem

Background: Aging is associated with decreases in physical function. It is therefore necessary to find exercise programs that are feasible and adherent for older adults. Golf is a unique, multimodal exercise that encompasses aerobic, power, agility, and balance training. **Purpose:** The purpose of this study was to investigate the effect of a 10-week golf program on measures of physical function in healthy, older adults. **Methods:** 15 healthy, older adults were enrolled in a 10-week golf program with fitness testing before and after the intervention. Participants completed 283/300 sessions (94%) and there were no adverse events or drop-outs related to the golf program. One participant dropped out of the study due to a work-related injury. Paired t tests were used to determine significance. Results are shown as mean \pm SD with Cohen's d effect sizes. **Results:** There were statistically significant changes in timed up & go ($p < 0.001$), 30-second chair stand ($p = 0.006$), average grip strength ($p = 0.017$), maximum hip abductor strength ($p = 0.005$), and heel raise ($p = 0.014$). There were no changes in average quadriceps strength ($p = 0.805$) or six-minute walk distance ($p = 0.097$). **Conclusion:** Golf is a unique, multimodal activity that has a beneficial impact on fitness in healthy, older adults. The high adherence rate shows that the participants found the program to be enjoyable and feasible. Golf should be encouraged as a physical activity program for older adults.

Poster #118

Title: Effects of Blood Flow Restriction with Eccentric Training on Muscle Fatigue, Strength, and Hypertrophy

Authors: Malcolm Jones and Todd Schroeder

Faculty advisor: Todd Schroeder

Gotsis, Vangelis Lympouridis and James M. Finley

Faculty advisor: James Finley

People with Parkinson's disease (PD) experience deficits in gait and balance that dramatically reduce their quality of life. Many of these deficits are not ameliorated by dopaminergic medication, which is the most common clinical intervention used to improve motor symptoms in PD. However, emerging evidence suggests that physical activity can improve motor function in individuals with PD through experience-dependent changes in brain structure and function. Here, we describe the creation and evaluation of a virtual reality (VR) application, called 'Wordplay VR', designed to improve mobility in people with PD. The objective of the application was for users to complete a puzzle that consisted of a word with missing letters, by collecting the necessary letters as they floated in a three-dimensional virtual space and placing them in their appropriate location. Nine people with PD completed three test sessions, and each session was directed by one of eight physical therapists (PTs) who set features of the gameplay that influenced the level of challenge. Our primary outcome measures assessed adverse effects of VR exposure, sense of presence, levels of motivation and system usability. All participants successfully completed the sessions, with no adverse events. Both people with PD and PTs were intrinsically motivated to perform well at their respective tasks. While the usability of the game was generally high, further application development is needed to enhance the therapist's user experience. Overall, we present evidence that our im-

mersive overground mobility training system is feasible and acceptable by people with PD and their therapists.

Poster #119

Title: Evaluation of a Fully-Immersive Mobility Training System for Parkinson's Disease

Authors: Shreya Jain, Aram Kim, Beth Fisher, Marientina

Faculty advisor: James Finley

People with Parkinson's disease (PD) experience deficits in gait and balance that dramatically reduce their quality of life. Many of these deficits are not ameliorated by dopaminergic medication, which is the most common clinical intervention used to improve motor symptoms in PD. However, emerging evidence suggests that physical activity can improve motor function in individuals with PD through experience-dependent changes in brain structure and function. Here, we describe the creation and evaluation of a virtual reality (VR) application, called 'Wordplay VR', designed to improve mobility in people with PD. The objective of the application was for users to complete a puzzle that consisted of a word with missing letters, by collecting the necessary letters as they floated in a three-dimensional virtual space and placing them in their appropriate location. Nine people with PD completed three test sessions, and each session was directed by one of eight physical therapists (PTs) who set features of the gameplay that influenced the level of challenge. Our primary outcome measures assessed adverse effects of VR exposure, sense of presence, levels of motivation and system usability. All participants successfully completed the sessions, with no adverse events. Both people with PD and PTs were intrinsically motivated to perform well at their respective tasks. While the usability of the game was

generally high, further application development is needed to enhance the therapist's user experience. Overall, we present evidence that our immersive overground mobility training system is feasible and acceptable by people with PD and their therapists.

Poster #120

Title: Compensation for interaction torques during single-joint movement in stroke survivors

Authors: Yannick Darmon, Victor Barradas and Nicolas Schweighofer

Faculty advisor: Nicolas Schweighofer

Background: Flexion and extension of the elbow generate torques at the shoulder and other proximal and distal joints. These forces generated are called interaction torques and arise from the acceleration and velocity of the limb about its joint. To maintain accuracy, the central nervous system learns to compensate for these torques by activating compensatory muscles before the prime movers of the movement. This pre-programmed muscle activity involves feedforward controllers that are thought to be updated by the cerebellum. However, in stroke survivors, the death of neurons occurring in motor cortical areas may indirectly provoke the death of cells in the cerebellum by a phenomenon called diaschisis. Damage in the cerebro-cerebellum pathways may, therefore, precludes stroke survivors from updating their feedforward controllers. **Purpose:** In this experiment, we investigate if stroke survivors present abnormal muscle activation and aberrant scaling for interaction torque compensation. **Methods:** We recruit stroke survivors and healthy age-matched control. During both single-joint elbow flexion and extension, we explore the relationships between the generated interaction torques and the electromyographic (EMG) activity of the shoulder

and elbow muscles. **Results:** Pending. **Conclusions:** Pending.

BIOKINESIOLOGY & PHYSICAL THERAPY POST-DOCS & RESIDENTS

Poster #121

Title: mHealth technology in stroke survivors: a scoping review protocol

Authors: Camila Torriani-Pasin, Janaine Cunha Polese, Marika Demers, Lauri Bishop, Eric Wade, Susanne Hempel and Carolee Winstein

Faculty advisor: Carolee Winstein

Background: mHealth Technologies are being used to measure functional movement behavior outside clinical settings. Detailed information about the measurement properties of these technologies is needed to best guide clinicians and researchers to choose and apply the appropriate technology in practice. **Purpose:** The aim of this scoping review is to provide a critical analysis of measurement properties of mHealth technology (wearable sensors and smartphone applications) currently used to capture two classes of purposeful movement behaviors (walking steps and arm and hand use) and to evaluate the intensity of these behaviors (moderate to high levels of physical activity, vs low levels including sedentary behavior) in stroke survivors. **Methods:** We searched 4 databases to identify studies investigating the psychometric properties of mHealth technologies used to capture functional movement behaviors in stroke survivors. The team extracted measurement properties (reliability, validity, responsiveness, and interpretability) and sample characteristics of all eligible publications. The review is registered in the Open Science Framework (osf.io/fqs3d). **Results:** The search strategy yielded 1380 citations

of which 64 were included for data extraction and synthesis. We identified 17 mHealth technology evaluations for upper limb measurement and 47 for lower limb measurement. Validity, accuracy, and reliability were reported in 36, 32 and 34 publications, respectively. Responsiveness was only reported in 7 publications and there is a lack of intensity information. **Conclusion:** This scoping review serves as a starting point for knowledge and technology development of well-designed efficacy trials of emerging technologies for inducing health-promoting levels of functional movement behaviors in stroke survivors.

Poster #122

Title: Do fundamental brain connections explain higher rates of chronic pain in specific body regions?

Authors: Amy K. Hegarty, Moheb S. Yani, Alaa M. Albishi, Lori A. Michener and Jason J. Kutch

Faculty advisor: Jason Kutch and Lori Michener

Background: The salience network is important for pain processing. Functional connectivity of the salience network to the sensorimotor cortex is altered in chronic pain. However, little is understood about their fundamental communication in the absence of pain. **Purpose:** The purpose of this study was to map salience network functional connectivity across the sensorimotor cortex in healthy individuals. **Methods:** Using electromyography and task-based functional magnetic resonance imaging (fMRI), we first localized distinct regions-of-interest across sensorimotor cortex in medial (gluteal), intermediate (shoulder), and lateral (hand) areas. We then used resting-state fMRI of healthy individuals from two public repositories to map salience network functional connectivity across sensorimotor cortex using the 3 anchor regions. **Results:** We found significant heterogeneity in functional connectivity strength between sensorimotor regions-of-inter-

est the salience network. We further examined these inconsistencies by plotting the continuous functional connectivity to the salience network. On a flattened map of sensorimotor cortex, we also observed heterogeneity with relatively high functional connectivity to the salience network for trunk and face regions, and low functional connectivity for extremities including the hands and feet. **Conclusion:** We conclude that sensorimotor cortex cannot be considered spatially homogeneous in its interaction with other large-scale brain networks. Different sensorimotor regions on the body surface may be prioritized differently for pain and threat assessment by the salience network.

OTHER BIO- KINESIOLOGY & PHYSICAL THERAPY RESEARCHERS

Poster #123

Title: A preoperative interdisciplinary model for those undergoing orthotopic neobladder surgery

Authors: Peter Muhn, Lisa Tan, Kelsie Kaiser, Brian Sterling, April Spina, Kimberly Lenington, Sylvia Rodriguez, Judea Sy, Seyedeh Sanam Ladi Seyedian and Sia Daneshmand

Background: Preoperative patient education is correlated with long-term patient satisfaction (Kretschmer 2017); however, this concept is less common in the area of pelvic health. Stress urinary incontinence (SUI) is a common problem that occurs after a cystectomy (Ahmadi, 2013), which directly impacts patients' functioning and quality of life (QoL). Pelvic floor muscle training has been demonstrated to improve SUI preoperatively (Tienforti 2012, Patel 2013, Hirschoorn 2014, Chang 2016) and postoperatively (Sayilan 2018). **Purpose:** The purpose of this study is to

describe the role of preoperative interdisciplinary care in the successful management of SUI and overall satisfaction in individuals undergoing cystectomy. **Methods:** A retrospective study was conducted via survey to patients who attended the preoperative class between the years 2016-2020. Inclusion criteria: those who underwent the orthotopic neobladder surgery and > 3 months post-procedure. The survey consists of questions regarding the patients overall satisfaction in regards to continence, quality of life, post-operative expectations and if they felt they had the support and knowledge needed to cope with the post-operative changes. **Results:** Pending our IRB approval, we have not attained our results of this survey. **Conclusions:** Our study serves to fill a missing piece in neobladder continence research. We anticipate our results will demonstrate positive trends in patient confidence, satisfaction and QoL post-operatively. The study will also serve as a stepping-stone for further research and development of best practice medicine for this population in regards to pelvic health.

Poster #124

Title: Effect of NuStep on Gait after Chronic Stroke

Authors: Samantha Atty, Trevor McCready, Nicholas Siekirk, Q. Lai, Victoria Pardo and Sujay Galen

Faculty advisor: Nicholas Siekirk

Background: A recumbent cross trainer (RCT) relies on similar neural networks as gait. **Purpose:** The purpose of this investigation was to compare effects of the RCT and Treadmill (TM) on intra-exercise electromyography and post-exercise spatial-temporal gait parameters. **Methods:** 34 participants were divided into two groups: stroke (CVA) (10 ± 5 years post-CVA) and age/sex-matched controls. Participants completed two 5-minute exercise bouts on both the RCT and TM at a RPE based

self-selected cadence. The Wireless Gait Assessment Tool (WiGAT) evaluated gait parameters immediately following each exercise bout (3 x 10m walk). **Results:** Stroke (n = 15) and healthy (n = 19) did not differ in age (Mdn: 66 years vs. 57 years, respectively) or BMI (Stroke: M = 27.02, SD = 4.57 vs. Healthy: M = 26.46, SD = 4.63), $p > .05$. Healthy participants were stronger at all joints, $p < .025$. Healthy controls preferred faster TM speed, despite no statistical difference in RPE, $p < .05$. RCT average steps/min did not differ between conditions, $p > .05$. RPE did not differ between groups or across exercise modes. WiGAT determined RCT decreased stance percentage (%) and increased swing % on the non-affected leg, $p < .05$. Neither exercise mode modulated the affected-side stance %, affected-side swing %, double support time, or bilateral (affected vs. non-affected) stride length, $p > .05$. **Conclusion:** Five minute RCT intervention improved non-affected side gait parameters in a chronic CVA population.

OCCUPATIONAL SCIENCE & OCCUPATIONAL THERAPY FACULTY

Poster #125

Title: Investigating Developmental Norms of Infants and Children in Rural Armenia

Authors: Allison Phillips and Grace Baranek

Background: The health of infants and children in Armenia has been affected by a variety of socioeconomic, environmental, educational, and behavioral factors, displaying trends typical for both developed and developing countries. Prior to Armenia's independence from the Soviet Union in 1991,

children with disabilities were perceived as "defective" and kept hidden in the home. Due to the lasting shame and fear of stigmatization, developmental disorders and disability are relatively new issues in Armenia. Low birth weight, young age of mothers, living in a rural area, and the presence of other sick children in the family have been identified as risk factors for developmental delay in the Tavush region of Armenia. **Purpose:** To better understand the development of infants and children living in the southern regions of rural Armenia utilizing an adapted version of the CDC's Developmental Milestone Checklist. **Methods:** The CDC Milestone Checklist was translated into Armenian and back-translated to assure validity, reliability, and cultural relevance. Participants (n=98) were recruited from the rural villages of Sisian and Kapan, Armenia. Once consented, caregivers were asked to complete the translated checklist and provided feedback from an occupational therapist regarding their child's development. **Results:** Participants presented with general delays in cognitive and language and communication areas. Out of the 98 participants, 3 children displayed significant delays (<50% of milestones passed). **Conclusion:** Overall, infants and children in rural Armenia displayed developmental trends similar to those of their U.S. peers.

Poster #126

Title: Tailoring an App for Seniors with MCI and Mild Dementia

Authors: Stacey L. Schepens Niemiec, Jeanine Blanchard and Sarah Barber

Background: Technology may improve health management of older people with cognitive deficits, yet these individuals may have unique needs impacting its utility. We developed a smartphone app, Moving Up (MU), to improve physical activity in older people. This study describes initial development of an adapted

version of the app, MU-A, for seniors with mild cognitive impairment (MCI)/mild dementia (MD). **Methods:** A rapid literature review and beta-test of MU in cognitively healthy older adults informed MU-A development. Literature review included a manual search for articles relevant to digital health technology and MCI/MD. Three focus groups (n=4-5/grp) were held after a 2-week beta-test to gather cognitively healthy users' experiences with MU. We synthesized results, identified features aligned with best practices for MCI/MD, deliberated necessary adaptations, and integrated changes into MU-A. **Results:** Many elements of MU (e.g., high-contrast colors, simplistic menus) already aligned with techniques to maximize usability in seniors with MCI/MD. We produced a second MU version by incorporating beta-test feedback and findings examining the relationship between DFA, SOR, and OHBO in individuals across the lifespan were included (n=60). Articles examining a disability population or relationships with constructs such as socioeconomic status or race/ethnicity were excluded. In an iterative process, constructs were organized into a conceptual model. **Results:** Relationships exist between DFA and general anxiety, SOR, pain catastrophizing, dental behavior management problems (DBMP), oral health, dental attendance, and the need for pharmacological methods to complete care. Likewise, SOR has been linked to general anxiety, pain catastrophizing, DFA, DBMPs, and need for pharmacological methods. Additional relationships exist between DBMPs and need for pharmacological methods; poor oral health was also associated with dental attendance and need for pharmacological methods. **Conclusion:** DFA is a complex and multi-faceted issue with serious health implications. By understanding the interplay of the factors associated with DFA, such as SOR, we can develop novel intervention techniques to target these related constructs in order to improve oral health outcomes and behaviors.

OCCUPATIONAL SCIENCE & OCCUPATIONAL THERAPY DOCTORAL STUDENTS

Poster #127

Title: Dental fear/anxiety, sensory over-responsivity, and oral health: A conceptual model

Authors: Mollianne Grager and Leah Stein Duker

Faculty advisor: Leah Stein Duker

Background: Dental fear/anxiety (DFA) is an excessive negative emotional state or reaction to dental treatment. Prevalence estimates range from 5-42% for children and 11-27% for adults, with DFA linked to multiple negative oral health behaviors and outcomes (OHBO). Sensory over-responsivity (SOR) has likewise been linked to these OHBO, but minimal research has examined the relationship between DFA and SOR. **Purpose:** To present a conceptual model of DFA, SOR, and OHBO. **Methods:** The PubMed database was searched; terms included dental fear/anxiety, oral health, sensory processing, etc. Studies examining the relationship between DFA, SOR, and OHBO in individuals across the lifespan were included (n=60). Articles examining a disability population or relationships with constructs such as socioeconomic status or race/ethnicity were excluded. In an iterative process, constructs were organized into a conceptual model.

Results: Relationships exist between DFA and general anxiety, SOR, pain catastrophizing, dental behavior management problems (DBMP), oral health, dental attendance, and the need for pharmacological methods to complete care. Likewise, SOR has been linked to general anxiety, pain

catastrophizing, DFA, DBMPs, and need for pharmacological methods. Additional relationships exist between DBMPs and need for pharmacological methods; poor oral health was also associated with dental attendance and need for pharmacological methods. Conclusion: DFA is a complex and multi-faceted issue with serious health implications. By understanding the interplay of the factors associated with DFA, such as SOR, we can develop novel intervention techniques to target these related constructs in order to improve oral health outcomes and behaviors.

Poster #128

Title: Correlations between Observed and Caregiver-Reported Sensory Responsiveness

Authors: Emily Campi, John Sideris, Cristin Holland, Emily Sopkin, Yun-Ju Chen, Elixabeth Choi, Susan Agostine, Stephanie Bristol, Aaron Dallman, AManda Wiles, Linda Watson, Elizabeth Crais and Grace Baranek

Faculty advisor: Grace Baranek

Background: Many individuals with autism spectrum disorder (ASD) demonstrate atypical sensory processing, which impacts participation and is known to be associated with caregiver stress. Sensory processing is assessed via caregiver-report or observational measures of hyporesponsivity, hyperresponsivity, and seeking constructs; however, the correlation between these types of measures and moderators of this association have not been systematically investigated. **Purpose:** To test the correlation between caregiver-report and clinical observation measures of sensory processing with caregiver stress as a moderator of the strength of correlation observed. **Methods:** Measures included the Sensory Processing Assessment (SPA, observational measure), the Sensory Experiences Questionnaire (SEQ, caregiver-

er-report), and the Caregiver Strain Questionnaire (CGSQ). Pearson correlations were computed across measures for N=269 2-12 year-old children with ASD, developmental disorders (DD), or typical development, controlling for chronological age (CA) and IQ. A series of regression models of SEQ scores were run with SPA, CGSQ, and their interaction entered hierarchically for the subset of children with ASD and DD, covarying for CA and IQ. **Results:** SPA and SEQ construct score correlations were .24-.28 (all $p < .001$). CGSQ subjective externalized strain was not correlated with SPA/SEQ scores, subjective internalized strain was correlated with SEQ construct scores ($r = .27-.28$, $p < .02$), and objective strain was correlated with SEQ hyporesponsiveness and hyperresponsiveness ($r = .31-.39$, $p < .007$). Increased CGSQ subjective externalized strain predicted a stronger correlation between SPA and SEQ seeking scores ($F(1,55) = 6.00$, $p < .02$). **Conclusion:** Best practice for assessing sensory processing should consider multiple informants and explore caregiver factors that may be contributing to outcomes.

Poster #129

Title: Prevalence and Differentiating Patterns of Sensory Symptoms among 3-year-olds

Authors: Yun-Ju Chen, John Sideris, Linda Watson and Grace Baranek

Faculty advisor: Grace Baranek

The current study used the Sensory Experiences Questionnaire (SEQ v2.1), a well-validated parent-report measure of children's responses to sensory stimuli in daily activities, to examine the prevalence of sensory symptoms across a community sample of 3-year-olds. We also aimed to clarify whether differentiating patterns of sensory symptoms were present among those with and without autism spectrum disorders (ASD). 2,198 parents with a child aged 3 years completed a set of online surveys about

their child's developmental outcomes, including the SEQ, Developmental Concerns Questionnaire (DCQ), and Social Responsiveness Scale (SRS). The DCQ and SRS were used for determining the child's diagnostic status, resulting in 3 groups: 71 with ASD, 131 with other diagnoses, and 1,996 without any diagnosis. Wald chi-square tests were used to detect diagnostic group differences in the proportion of participants with various levels of sensory challenges. The main effects of diagnostic group on the SEQ subscale scores were assessed using ANCOVA with sex as a covariate. As a result, the estimated prevalence of sensory deficits was significantly higher in 3-year-olds with ASD. 2.7% of the children with non-ASD conditions did show severe sensory symptoms, indicating the possibility of sensory processing disorder in the preschool-aged general population. The results also revealed that ASD can be distinguished from non-ASD based on parent-report sensory symptoms. Specifically, largest group differences were found in hyperresponsiveness and hyporesponsiveness. The group differences observed in both social and non-social contexts might indicate more general deficits in sensory responsiveness regardless of social factors in children with ASD.

Poster #130

Title: Imbalanced Dual Systems of Decision Making in Stroke

Authors: Kaori L. Ito, Laura Cao, Renee Reinberg, Nicolas Schweighofer and Sook-Lei Liew

Faculty advisor: Sook-Lei Liew

Background: In the healthy brain, decision-making is driven by a balance between habitual and goal-directed systems. This dual-system balance shifts towards greater habitual actions in healthy aging, while younger adults who have greater working memory (WM) show greater goal-directed

behavior. Stroke typically occurs in older adults and can cause significant neurological damage resulting in functional deficits, but how stroke impacts this balance is unknown.

Purpose: We examine whether stroke further impairs the dual-system balance beyond healthy aging, and the effect of stroke on the relationship between WM and dual-system balance. **Methods:** Twenty participants (12 YA, 4 OA, 4 stroke) completed WM6 and decision-making tasks. A measure of the dual-system weightings (w) was derived from the decision-making task and compared between groups using a Kruskal-Wallis test. The effect of group on the relationship between w and WM, with OA as referent, was examined with an interaction model.

Results: w was significantly different between groups ($\chi^2 = 6.84$, $p = 0.03$), with YA being most goal-directed, followed by OA, and stroke being most habitual. Significant differences were found only between YA and stroke ($Z = -2.42$, $p\text{-adj} = 0.04$). For the interaction model, we found a main effect of w ($\beta_w = 25.41$, $p < 0.01$). Both stroke and YA had significant effects on the relationship between WM and w compared to OA ($\beta_{\text{stroke:w}} = 39.56$, $p = 0.04$; $\beta_{\text{YA:w}} = 9.87$, $p = 0.02$). **Conclusion:** These preliminary results suggest that stroke may alter the dual-system balance in decision-making beyond normal age-related effects, and may alter the relationship between dual-system balance and WM. More data is needed to draw more conclusive results.

Poster #131

Title: VR-based motor recovery for chronic stroke survivors: A pilot study

Authors: Miranda Rennie and Sook-Lei Liew

Faculty advisor: Sook-Lei Liew

Background: Previous research indicates that action observation (AO; Celnik et al., 2008) and virtual reality (VR; Bermúdez i Badia et al.,

2016) can improve severe motor impairment in people with chronic stroke. **Purpose:** The current study evaluates the effectiveness and feasibility of REINVENT, a platform that incorporates principles of AO and VR. EMG signals indicating attempted wrist movements in the hemiparetic arm drive an avatar's wrist movement in VR, creating a biofeedback loop with the purpose of avoiding coactivation of agonist and antagonist muscles. **Methods:** We are conducting a pilot study of the REINVENT EMG training program, with pre and post-intervention testing on days 1 and 10, respectively. Outcome measures include the Action Research Arm Test, dynamometry for grip strength, the upper extremity Fugl-Meyer, and the Montreal Cognitive Assessment. Paired t-tests were used to compare pre and post intervention data across four participants and descriptive data was analyzed for each case. **Results:** Preliminary results at the group level indicate no significant differences and at the case level indicate clinically important differences for two participants. **Conclusion:** REINVENT has the potential to be an effective intervention for motor recovery for chronic stroke survivors, though additional research is required to optimize the platform. A discussion of the feasibility of REINVENT and opportunities for further research and development will be included.

Poster #132

Title: VR Cyberball: Modulation of social ostracism in an immersive environment

Authors: Aditya Jayashankar, Samantha Noor, Jonas Kaplan, Lisa Aziz-Zadeh and Laura Harrison

Faculty advisor: Lisa Aziz-Zadeh

Background: Social exclusion is highly aversive to mental health (MacDonald & Leary, 2005). Cyberball (Williams & Jarvis, 2006) - a cartoon ball-tossing game - was designed to study the neuropsychology of ostracism. Though

used in many studies (Hartgerink et al., 2015), questions remain about the induced experiences. **Purpose:** (1) To determine whether a virtual reality (VR) version of Cyberball elicits heightened immersion compared to the original, and (2) to investigate behavioral responses to perceived intentional ostracism through non-player gaze manipulation. **Methods:** 14 participants ages 18-27 (11 female) played cartoon and VR Cyberball (2 conditions - without and with intentional gaze cues) in counterbalanced orders. The Immersive Tendencies Questionnaire (Witmer & Singer, 1998) and the Sense of Presence Inventory (SOPI; Lessiter et al., 2001) were completed on arrival. Williams' Needs Threat Scale (Williams et al., 2000) was collected post-hoc. **Results:** All SOPI scores were higher for the VR version ($p < 0.01$). Females reported significantly higher between-version differences of spatial presence ($p = 0.019$) and ecological validity (EV) ($p = 0.012$) sub-scales. Regression modelling revealed age ($p = 0.007$), gender ($p = 0.017$), tendency to become passively involved ($p = 0.031$), and between-version differences in feelings of control ($p = 0.021$) together predicted EV score differences. Gender aside, EV had negative relationships with the predictors. Between VR conditions, age predicted differences in self-esteem while tendency to become focused and VR EV predicted differences in feelings of control. **Conclusion:** VR Cyberball is more immersive, and its gaze manipulation is detectable. Future endeavors will apply this modality to identify neural responses to the intentionality of ostracism.

Poster #133

Title: Relationships between Sensory Features and Behavioral Problems in Neurodevelopmental Disorders

Authors: Cristin M. Holland, John Sideris, Elizabeth Choi, Allison Q. Phillips and Grace T. Baranek

Faculty advisor: Grace Baranek

Background: Children with autism spectrum disorder (ASD) and other developmental delays have demonstrated increased behavioral problems, and sensory features have been linked with behavioral problems behaviors in both typical and clinical populations of children. However, there is limited research examining possible causal and bidirectional associations between sensory features and behavioral problems in children with neurodevelopmental disorders, such as ASD.

Purpose: To assess if sensory features predict behavioral problems behaviors in children with neurodevelopmental disorders. **Methods:** Measures of sensory features (Sensory Experiences Questionnaire) and behavioral problems (Child Behavior Checklist [CBCL]) at two time points (T1 age $M = 78.65$ months, $SD = 34.03$ months; T2 age $M = 108.34$, 31.18) were extracted from a longitudinal data set with a sample of $N = 31$ children with ASD or developmental delays. Hierarchical linear models were used to test the association of hyperresponsiveness, hyporesponsiveness, and sensory interests with CBCL Total Problems and several sub-scales, and whether those associations were moderated by age and diagnosis. **Results:** Results indicated positive associations with Total problems and both hyperresponsiveness ($std B = .48$, $p < .001$) and hyporesponsiveness ($std B = .26$, $p = .004$), but no moderation by age or diagnosis. These results were largely replicated in the subscales, with possibly even greater distinction between hypo and hyper for internalizing and externalizing scales.

Conclusion: Results suggest sensory features may influence later behavioral problems in children with neurodevelopmental disorders, and certain features, such as hyperresponsiveness, may have greater impact on behavioral problems than others. Additional analyses (SEM) will be run to examine predictive relationships patterns across subscales.

Poster #134

Title: Autism Spectrum Disorder assessment in Latino Children in the USA

Author: Valentina Vera Carrasquero

Faculty advisor: Grace Baranek

Background: Latino families in the United States often have decreased access to healthcare, less culturally relevant information of ASD, and therefore, lower levels of ASD awareness. Consequently, they are an underserved population with regards to ASD assessment. Awareness of current situation is necessary to address systemic barriers and provide inclusive care.

Purpose: To examine current barriers to ASD assessment in Latino children and highlight best practices to ensure culturally appropriate and sensitive assessment. **Method:** A literature search was conducted in PubMed, COCHRANE and CINAHL. The search terms were (Latino AND (children OR family) AND (autism OR autism spectrum disorder)). Articles focusing solely on children with ASD were included. Both qualitative and quantitative research were included. Articles were appraised using appropriate appraisal criteria depending on the research methodology. GATE, RAMBOMAN and Tracy's 8 Big Tent Criteria. **Results:** The search yielded 99 articles, 18 of which pertained to ASD assessment. The predominant barriers to ASD assessment were lack of accessible healthcare and the language barrier encountered between health care providers and Spanish speaking clients. Best practices to address these needs are carefully reviewing background information, selecting appropriate assessments, building rapport, and open communication between multidisciplinary teams. **Conclusions:** Latino families living in the United States face barriers when accessing healthcare, which affects the development of their children and family outcomes. If the identified best practices were incorporated by healthcare professionals, it would benefit this population by increasing

awareness of ASD and enhance the delivery of culturally appropriate health services.

Poster #135

Title: Effects of extracurricular activity participation on college students' health

Authors: Buwen Yao, Sandy C. Takata and Shawn C. Roll

Faculty advisor: Shawn C. Roll

Background: Adjusting to a new environment is a challenge for college students, and involvement in extracurricular activities can support the transition to college-life. However, the relationship of participation in specific extracurricular activities to student health is largely unknown. **Purpose:** To characterize extracurricular activity participation in college students and explore how participation relates to overall physical and mental health. **Methods:** Data were collected from 159 college students through self-reported surveys at the beginning of their academic program and at the conclusion of each of the two successive academic years. An activity checklist was used to record the total hours of participation in a variety of activities within eight occupational categories over the previous six months. The SF-36 was used to measure physical and mental health [i.e., physical component score (PCS) and mental component score (MCS)]. Mixed linear models were developed to examine the associations between participation in different occupational categories and PCS and MCS. **Results:** Average time spent in sports, fitness, social, and work occupations decreased across time, while the average time spent in creative arts, animal care, and caregiving remained similar. While the majority of the participants' PCS and MCS scores were at or above the average general population level, the MCS score decreased at 1-year follow-up. Multiple associations between occupational category and PCS and MCS were

identified. **Conclusion:** Participation in certain extracurricular activities has a potential benefit to college students' overall health. Further research is needed to identify methods to allow, encourage, or promote more participation by students.

Poster #136

Title: Understanding Office Work Behavior to Inform an Artificial Intelligence Workstation

Authors: Yoko E. Fukumura, Burcin Becerik-Gerber, Gale M. Lucas and Shawn C. Roll

Faculty advisor: Shawn C. Roll

Background: Workplace behaviors are often ingrained in individual's habits, roles, and routines. Behavioral patterns, such as poor posture, are difficult to change even when they are detrimental to a worker's health. Artificial intelligence (AI) can provide individual monitoring and real-time feedback to improve health behaviors; however, little is known about individual variability in worker behavior, particularly in office settings. **Purpose:** To understand different patterns of worker behaviors in an office setting as a foundation for developing AI sensing/feedback technology. **Methods:** Twenty healthy adults were observed for two hours while working in different setups of an office workstation. Two cameras recorded the session, and self-reported discomfort data were obtained. Noldus Observer XT software was used to analyze and code worker behaviors including durations of static and dynamic movements, ways of engaging with work tasks, and participant postures. **Results:** Different coding schemes were evaluated through an iterative development and review process to identify a protocol most useful for interpretation and informing AI development. The final coding scheme provided a means for recording variability in individual working habits. Specifically, identifying static postural thresholds and exploring key behavioral inputs that differ across workers, both useful in training an

AI system. **Conclusions:** Use of behavioral and observational data will provide important support in developing robust AI models to improve health. This system can be augmented with feedback methods and training in real-time learning of individual preferences to develop a full AI workstation to promote worker health.

Poster #137

Title: Characterizing Working Posture and Injury Risk in Dental Hygiene Students

Authors: Jody C. Liu, Kryztopher D. Tung, Nancy A. Baker, Jane L. Forrest and Shawn C. Roll

Faculty advisor: Shawn C. Roll

Background: Up to 70% of dental hygienists experience musculoskeletal disorders (MSDs); many experience pain and discomfort beginning in their educational program. Despite the high prevalence of MSDs amongst this population, limited research exists on the association between working posture during hand scaling, clock position, and self-reported pain outcomes. **Purpose:** To quantify the relationships between working posture, clock position, and self-reported pain levels to inform preventative measures. **Methods:** We used the Rapid Upper Limb Assessment (RULA), an ergonomic assessment tool, to evaluate postural risk through video recordings of 16 dental hygiene students in the second year of their program. Three treatment sessions were analyzed per participant at 3 time points (1 per semester). Each session was scored at 10 different time points using the RULA (480 total scores) with sample selection weighted by time spent in different clock-positions. These scores were analyzed to characterize common/extreme postures, and overall risk. Self-reported pain was collected each semester and correlated with postural risk data. **Results:** The average across all RULA scores was 5.04 (SD=1.21, [2.00-7.00]) indicating mod-

erate to high injury risk. The clock-position associated with the highest RULA scores was at 9 o'clock (mean=5.47, SD=1.09). The students with pre-existing musculoskeletal pain at baseline were not significantly different from students without pain ($p=0.08$, $\beta=0.33$). **Conclusion:** On average, moderate to high RULA scores raise concern regarding potential injury risk. Certain clock-positions may expose students to higher risk of developing MSD. Further exploration of the relationship between RULA scores and pain at different time points is needed.

Poster #138

Title: Screening for Autism in Preterm Infants from a Community Sample

Authors: Elizabeth Choi, John Sideris, Claire Chen, Emily Campi, Amanda Wiles, Valentina Vera Carrasquero, Cristin Holland, Helen Lee, Linda R. Watson, Elizabeth Crais and Grace T. Baranek

Faculty advisor: Grace Baranek

Background: Autism screening tools used with preterm infants must demonstrate that they capture risk for diagnosis and are not biased based on prematurity. **Purpose:** We used confirmatory factor analysis to test whether social communication (SC) and sensory regulatory (SR) domains on the First Years Inventory version 3.1 (FYI) performed equivalently across groups from a community sample. **Methods:** We analyzed 27 core items across preterm ($n=400$) and full-term infants ($n=4,568$) across "9-month" (8-10 months adjusted; preterm $n=219$) and "12-month" (11-13 months adjusted; preterm $n=181$) groups. We tested configural, metric, scalar, and residual models and evaluated fit using chi-square estimates, comparative fit index, and root mean square error of approximation. **Results:** Models were invariant for 9-month groups with significantly higher preterm SC mean scores. There was

partial invariance for 12-month groups and significantly more preterm SC variance. **Conclusions:** Given good configurational and metric fit for the factor structures and loadings, parents from both groups in our sample interpreted the FYI's SC and SR questions similarly, providing preliminary evidence for using the FYI in the preterm population. However, partial invariance in the 12-month preterm group on SC and SR domains reflects differences in average levels of parent responses (on a scale of "never" to "always") as a function of prematurity, suggesting potential bias and a need to adjust scoring for preterm infants 11-13 months adjusted.

Poster #139

Title: Enhancing Care for Individuals with Autism: Potential for Interdisciplinary Collaborations

Authors: Dominique H. Como, Leah I. Stein Duker and Sharon A. Cermak

Faculty advisor: Sharon A. Cermak

Background: Oral health is a major public health concern, and children with autism spectrum disorder (ASD) are at greater risk for experiencing oral health disparities than the general population. As the current prevalence of ASD is 1 in 59 children, an increasing number of dental practitioners will encounter children with ASD in their practice. **Purpose:** Examine changes in ASD prevalence; Discuss challenges treating children with ASD poses for dental practitioners; and Describe unique collaborations between occupational therapists (OTs) and dentists to enhance care. **Methods:** Literature review exploring oral care challenges for children with ASD and their treating dentists, strategies to improve care for this population, and the benefits of interdisciplinary collaboration. **Results:** Research suggests that many dentists do not feel qualified to work with children with ASD. To address this, the dental field has worked to improve educa-

tional programming in dental school and continuing education. One of the most prominent approaches includes interprofessional collaborations (e.g., physicians, pharmacists). However, minimal research has discussed possible implications for dentistry-OT collaborations to improve care. **Conclusions:** Understanding the heterogeneity and symptomatology of ASD is important for all healthcare providers working with this population. Collaborating with OTs with expertise related to this population has the potential to enhance dental practitioners' understanding of ASD and help identify novel dental-related strategies. These dentistry-OT collaborations may occur at different levels of education and professional practice.

Poster #140

Title: Multisensory Environments for Individuals with Autism: A Systematic Review

Authors: Elizabeth Isralowitz, Molliane Grager, Sharon Cermak and Leah Stein Duker

Faculty advisor: Leah Stein Duker

Background: The sensory environments of education and healthcare settings have the potential to impact individual, caregiver, and provider outcomes. The Multisensory Environment (MSE) manipulates sensory features of the environment (e.g., visual, auditory, tactile), and is reported to improve relaxation, engagement, and reduce aggression in users, including individuals with autism spectrum disorder (ASD). Despite their common use, criticism exists regarding the quantity and quality of existing research supporting MSEs. **Purpose:** To systematically review and examine literature regarding the impact of MSEs on individuals with ASD. **Methods:** Eight databases were searched using keywords "Snoezelen/Multisensory Environment," "sensory room," "autis*" "ASD." Studies utilizing an MSE for individuals with ASD and published in English between 1990 and 2019

were included. Two independent researchers appraised methodological quality and level of evidence. **Results:** One hundred and thirty-three articles were screened. Eleven quantitative, six qualitative, and two mixed-methodology articles met inclusion criteria. Most quantitative studies were non-randomized (n=17), focused on children (n=11), and/or took place in schools (n=9). Outcomes examined included engagement, disruptive behaviors, and anxiety. Most studies reported mixed results (70%) with improvement on at least one outcome (e.g., cooperation, engagement, distress). None of the studies reported significant negative results and few examined carryover effects. The majority of studies (n=17) exhibited two or more methodological issues; despite this, 11 studies met a moderate to high level of evidence. **Conclusion:** Use of MSEs may be a promising intervention in individuals with ASD, but there is a need for more rigorous research into their efficacy and effectiveness.

Poster #141

Title: Using Sonography to Evaluate Healing of Surgically Repaired Flexor Tendons

Authors: Sandy C. Takata and Shawn C. Roll

Faculty advisor: Shawn C. Roll

Background: Each year, over 100,000 people experience a traumatic hand tendon injury. To successfully heal, a repaired tendon requires coaptation, unimpeded gliding, and adequate tensile strength—a process that takes 10-12 weeks. Currently, we lack precise measures or methods to evaluate and individualize rehabilitation protocols for tendon repairs, leading to suboptimal outcomes. Musculoskeletal sonography is the ideal modality to evaluate tendon healing with precision, ensuring a successful, efficient recovery. **Purpose:** Develop a longitudinal study design that we are implementing to es-

tablish a sonographic image acquisition and analysis protocol that evaluates the healing process of flexor tendons post-surgical repair. **Methods:** An extensive literature review was conducted to 1) develop a sonography protocol to standardize image collection and analysis and 2) identify candidate sonographic biomarkers associated with tendon injury, healing, and recovery. Based on literature findings, the protocol was pilot tested in healthy subjects and one participant recovering from a primary flexor tendon repair. Iterative review of image acquisition and analytic techniques occurred among the study team to refine the protocol. **Results:** Six sonographic biomarkers were identified: echogenicity, edema, hypervascularization; tendon excursion, thinning, and gapping. A detailed image acquisition protocol was developed and analysis of each biomarker was pilot-tested. This protocol will be further validated by evaluating intra-rater and inter-rater reliability and using mixed effects linear models. **Conclusion:** By establishing a reliable and sensitive sonographic protocol to evaluate post-surgical tendon healing with precision and across time, we can improve clinical decision-making to individualize care, thereby optimizing outcomes for this population.

Poster #142

Title: Sensory, Alexithymia, and Emotion Processing in ASD: an fMRI Study

Authors: Christiana Butera, Emily Kilroy, Laura Harrison, Aditya Jayashankar, Anusha Hossain, Alexis Nalbach and Lisa Aziz-Zadeh

Faculty advisor: Lisa Aziz-Zadeh

Background: Alexithymia is associated with atypical responses to sensory input. Individual differences in alexithymia may be associated with sensory sensitivities, and empathy in ASD. There is little understanding of the neural mechanisms involved in these relationships, outside of ex-

licit sensory stimulation. **Purpose:** To assess the relationship between scores on The Alexithymia Questionnaire for Children (AQC) and the Short Sensory Profile (SSP-2); and assess how performance on these scales relate to neural activity during emotional face processing in ASD. **Methods:** Data from 29 participants with ASD (mean age=12.0 ± 2.3) was analyzed. AQC was completed by participants, and the SSP-2 was completed by parents. fMRI data was collected on a 3-T Siemens MAGNETOM Prisma scanner while participants watched videos of emotional faces. Standard preprocessing was applied, and parameter estimates were extracted from bilateral amygdala using FSL's featquery. Pearson partial correlation was used to assess associations between neural activity, AQC, and SSP-2 scores. **Results:** The SSP-2 Register was positively correlated with the AQC identifying emotions score ($R=.438, p=.036$). There was a significant negative correlation between the Register profile and activity in the left amygdala during emotional face observation ($R= -.426, p=.038$). **Conclusion:** Alexithymia severity increased with a sensory under-responsivity score. Sensory under-responsivity was related to reduced activation in amygdala during emotion observation, complimenting previous work showing hyper-activation of amygdala in individuals with SOR.4 Results highlight modulation of amygdala activation as a function of sensory processing, and underscore the relationship between sensory and emotion processing in ASD.

Poster #143

Title: An innovative approach to assess uptake of Occupational Science literature using publisher metrics: an exploratory analysis

Author: Linah AlShalan

Faculty advisor: Mary Lawlor

Occupational science (OS) is a fast-growing discipline with

a wide range of audiences from various fields. The purpose of this analysis is to survey the current composition of OS literature and find which aspects of it have resonated most with readers. A unique approach was specifically designed for this purpose. A sample of 827 individually coded articles published by the Journal of Occupational Science between 1993-2019 was used to represent a slice of OS literature. Each article's Scopus, CrossRef, and AltMetric scores were collected and linked to the corresponding article's keywords and number of online views. Article keywords were used to systematically categorize research topics of the included sample. Audiences were divided into 3 categories: academic (Scopus and CrossRef), non-academic (online views), and engaged (AltMetric). Three lists were developed using consolidated keywords from top scoring articles in each of the included metrics. Lists were thematized to map focal points of each audience's interest. Intersections of different audiences' interests are highlighted as well as points of divergence. Key findings included: a disconnect between the academic and non-academic audiences' interests, the influence of trending social media discourse on non-academic metrics, and a causal relationship between article online views and other metrics in this analysis was revealed. Implications include using this innovative analytic approach to assess uptake of other disciplines in other fields, and creating a way to involve audience interactions with the literature to inform future directions of research and positionality of the science itself in the greater pool of scholarly knowledge.

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Poster #144

Title: Evaluating Hand Strain During the Dynamic Task of Dental Scaling

Authors: Kryztopher D. Tung, Joan Beleno, Jane L. Forrest and Shawn C. Roll

Faculty advisor: Shawn Roll

Background: The Revised Strain Index (RSI) is an ergonomic assessment tool for assessing exposure to physical strain during tasks (e.g., intensity, duration, posture) that can lead to risk of injury in the distal upper extremity. Applying RSI to dynamic work is a challenge when the task parameters frequently shift; therefore, a simplified method for grouping RSI input variables is desirable. **Purpose:** The goal of this study was to develop a methodology for grouping RSI input variables based on a pattern of physical exertion to enable automated calculation of an overall composite RSI score. **Methods:** Dental hygiene (DH) faculty were consulted to classify hand scaling patterns based on perceived physical effort and frequency of exertion using video footage of DH students performing scaling tasks. DH students ($n=14$) were observed in person while they performed hand scaling during patient clinic visits and every 15 minutes, scaling activity was classified into one of the three patterns. Participants rated their level of exertion on a scale of 1-10 at each time point and their hand/wrist posture was quantified. **Results:** Three distinct exertion classifications were identified during hand scaling (A=light, B=medium, and C=heavy). A significant correlation was found between exertion ratings and the three classifications ($R^2=0.46, p<0.01$). The average exertion values for scaling patterns were found to be A=2.75, B=4.24, and C=5.69. **Conclusion:** Our findings suggest that this method of classifying RSI inputs can be used to easily calculate composite RSI scores for a dynamic work task.

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Poster #145

Title: Quality of Online Patient Education Handouts for Carpal Tunnel Syndrome

Authors: Yiyang Fang, Juliana Dole, Nancy A. Baker and Shawn C. Roll

Faculty advisor: Shawn C. Roll

Background: Patient health education is an important component of healthcare management. Patients with orthopaedic conditions have demonstrated significant deficiencies in comprehending their diagnosis, which has contributed to poor healthcare outcomes. **Purpose:** In this study, we aimed to systematically evaluate the quality of carpal tunnel syndrome (CTS) patient education handouts available on the internet. **Methods:** Patient education handouts were identified through an internet search using Google and Bing and a manual search of notable professional organization websites. Handouts that met our inclusion criteria were evaluated in terms of content and understandability. Content analysis was conducted using a revised version of the Information Score (IS) scoring form related to information on symptoms, diagnosis and treatment options. Appropriate evidence-based interventions were identified based on a review of 7 clinical practice guidelines. The Patient Material Assessment Tool (PEMAT) and 5 widely used readability formulas were used to evaluate understandability. Descriptive analyses were performed using Excel and SPSS software. **Results:** 69 handouts were included in the analysis. The average score of the IS form was 68.12 and the average score of PEMAT was 70.96. The reading level of most handouts is higher than the recommended 6th-grade reading

level. Around 10% of handouts scored highly on both contents and understandability. **Conclusion:** This study identified a list of reliable CTS education handouts for clinicals and patients to utilize. Multiple problems that impacted the quality of CTS patient education handouts were revealed in this study and this would help improve online health information.

FROM
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STUDENT RESEARCH GROUP || **SRG**

To our fellow students, faculty, and staff,

We are extremely honored to present to you the Twelfth Edition of The Explorer Journal of USC Student Research. This year has been another exciting year for research and innovation here at the Herman Ostrow School of Dentistry of USC, the Mrs. T.H. Chan Division of Occupational Science and Occupational Therapy, and The Division of Biokinesiology and Physical Therapy.

We would like to acknowledge the wonderful efforts of all our fellow classmates and faculty that are engaged in research, and who continue to make meaningful breakthroughs for our profession. Our keynote speakers this year truly showcase the efforts our community is making towards advancing science. Now, more than ever we highly encourage all our fellow students to pursue research. There are so many exciting opportunities available here at USC.

Our annual Research Day would not be possible without the immense support we have received from our faculty advisors Dr. Yang Chai, Dr. Parish Sedghizadeh, and the entire Research Day planning committee. Our Student Research Group thrives on the encouragement and support we have received from our faculty advisors.

Thank you, and Fight On!
Yeonghee Jung & Teresa Ngyuen

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