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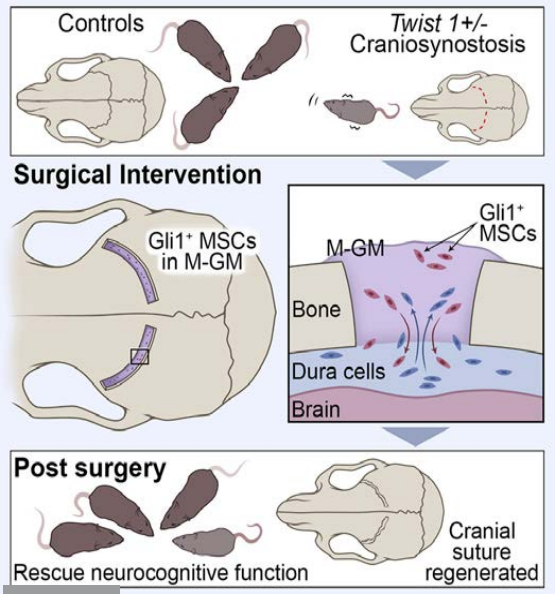
THE EXPLORER

Journal of USC Student Research

Herman Ostrow School of Dentistry of USC

THIS ISSUE

THE EXPLORER 2021



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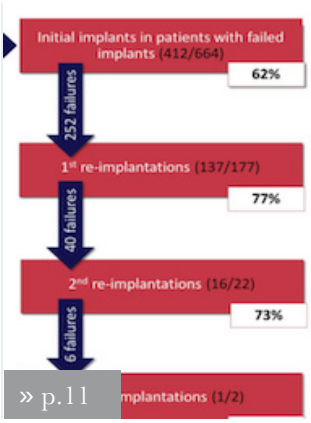

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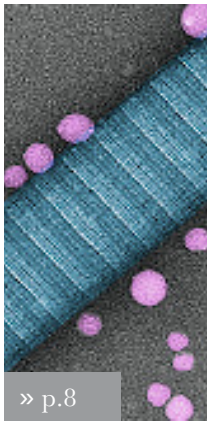
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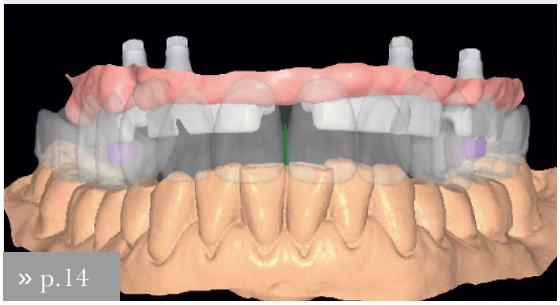
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DIVISION ARTICLES

Avishai Sadan, DMD, MBA
Dean
G. Donald and Marian James Montgomery Professor of Dentistry
Herman Ostrow School of Dentistry of USC

FROM THE **DEAN**

Dear Ostrow Students and Colleagues:

I'm so excited once again to be able to experience Ostrow's annual Research Day (virtually, of course) after we were forced to cancel last year's event because of limitations imposed by the COVID-19 global pandemic. Seeing the intellectual spark and scientific curiosity in our students and then reading about their discoveries in our award-winning *The Explorer* is a highlight every year.

Living through a global pandemic has given new shape and dimension to the importance of science and research. That scientists were able to provide us with several highly effective vaccines in such a short period of time is a testament to the immense power of scientific investigation and discovery. There truly is nothing we can't accomplish when we focus the world's leading minds on a problem.

For our own professions, research is rocket fuel, 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. It is our hope that during your time with us we impart within you this lifelong love of learning.

As part of a research-intensive university, we have always taken scientific investigation incredibly seriously. When the pandemic temporarily shuttered our lab spaces on both campuses, our researchers found creative and innovative ways to proceed. And when the University asked each school to create guidelines to allow for the safe resumption of research operations, it was an Ostrow task force, composed of researchers from dentistry, physical therapy and occupational therapy, that was so comprehensive in their plan that parts of it were adopted University-wide.

The pandemic did not slow our researchers down one bit. In fact, this year, Ostrow was No. 4 on the list of top-funded U.S. dental institutions by the National Institute of Dental and Craniofacial Research, up significantly from the No. 13 last year. This demonstrates such a significant amount of trust that the NIDCR has in our researchers, and I could not feel prouder of the work they do, day in and day out.

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 this year. 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 own field but also what your colleagues in all of our divisions are doing to continue strengthening the science undergirding their professions.

Stay safe, stay healthy, and Fight On!

INTRODUCTION TO RESEARCH DAY

Dear Ostrow Students and Colleagues,

We are excited to virtually welcome you to the 2021 Herman Ostrow School of Dentistry of USC Research Day. Next year, I look forward to seeing you all in person at our annual celebration at the Galen Center! Today, we honor our incredible students, staff, and faculty in Dentistry, Occupational Science, Occupational Therapy, Biokinesiology, and Physical Therapy who have worked extensively on their outstanding research endeavors despite the challenges of the past year.

It is an honor for all of us to have the opportunity to work with passionate students who dedicate their time and effort to pursuing cutting-edge research. The collaboration and sense of community within Herman Ostrow School of Dentistry are unlike any other. I have witnessed first-hand how compassionate our students are in helping one another, especially now in a moment of unprecedented change and uncertainty in the world. It is inspiring to witness the way our students and faculty have persevered and acclimated to the new "normal" by safely and creatively continuing their research at USC during this pandemic. Your work ethic and ability to withstand the challenges we faced this year have not gone unnoticed.

We strive to provide you with the best opportunities to promote your growth during your training at USC. You have proven to be exemplary leaders the world needs; leaders who devote themselves to their work and are driven to make a positive impact wherever they go. We hope that your research experience and training encourage you to continue to ask questions and explore unknown territories. We know that your research will continue to pave the way for new scientific discoveries in the future.

Our new issue of The Explorer includes a plethora of innovative research abstracts as well as articles that recognize some of our distinguished faculty members at Herman Ostrow School of Dentistry of USC. Our researchers who are represented in this issue are exemplary professional leaders who have proven through their work that they will continue to make remarkable contributions to science. I congratulate all of our students and researchers on their successes as we virtually come together to showcase their efforts on Research Day.

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

Bioengineering of *Enamel and Dentin*

Sumi Chung and Jessica Kim

Dr. Janet Moradian-Oldak is Professor of Dentistry in the Division of Biomedical Sciences at the Herman Ostrow School of Dentistry of USC and Professor of Biomedical Sciences and Bioengineering in the Department of Biomedical Engineering at the Viterbi School of Engineering of USC.

Dr. Moradian-Oldak received her bachelor's degree in Chemistry from Ben Gurion University in Israel. Her passion for science further led her to pursue a master's degree in Structural Chemistry and a Ph.D. in Structural Biology at Weizmann Institute of Science in Israel. After her Ph.D., she wanted to expand her knowledge in the biological sciences and decided to pursue postdoctoral training at USC, focusing on enamel protein biochemistry. Dr. Moradian-Oldak's previous work on the biomineralization of seashells and bone led her to investigate biomineralization in teeth, as the fundamental mechanisms of hard tissue formation are similar.

Dr. Moradian-Oldak's lab focuses on both basic science and translational research. Her current major areas of research involve the development of enamel and dentin, which she further aims to translate into novel developments for tooth mineralization. Her research strategy is unique and revolves around her lab's discovery of novel amelogenin-inspired synthetic peptides, which can be used to regenerate and repair both enamel and dentin. Dr. Moradian-Oldak's advances in remineralization of tooth structures holds the promise of great contributions to minimally invasive treatments that could extend the longevity of teeth and simplify oral care delivery. Enamel is an outer protective layer of the crown of the tooth. It consists of hydroxyapatite crystals that exhibit a preferred c-axis orientation, packed within rods that are separated by interrod structures. It serves as a wear-resistant outer layer of the dental crown as well as an insulating barrier that protects the underlying dental pulp from physical, chemical, and thermal forces that would otherwise be injurious. Enamel formation follows an organic matrix-mediated biomineralization process involving various structural hierarchies to provide mechanical support and prevent enamel deformation, which can be caused by excessive external forces. Enamel is the most highly mineralized tissue in the human body and is crucial for the function and structural support of a tooth; however, it is acellular, has extremely limited ability to remineralize, and does not possess the capacity to remodel or regenerate. Given the extremely high prevalence of tooth decay, researchers in the dental field have taken up the challenge of investigating minimally invasive strategies that could enable a more preventative approach to halt and even reverse carious lesions by remineralizing them. Thus, Dr. Moradian-Oldak and her team have investigated ways to rebuild enamel through bioengineering.

Biomimetic materials require careful manipulation of key elements of the composition, function, and structure of biological systems to produce material formulations with the desired properties. Since amelogenin plays a role in the formation of enamel, Dr. Moradian-Oldak together with her former graduate student, Dr. Kaushik Mukherjee, designed two synthetic amelogenin-inspired peptides of 26 and 32 amino acid residues (thus called P26 and P32, respectively). These synthetic amelogenins retained the vital functions of native amelogenin while they were able to effectively control apatite nucleation in vitro, which resulted in the formation of small, homogenous crystallites.

Dr. Moradian-Oldak's lab has demonstrated that repeated peptide applications can promote oriented nucleation of apatite crystal layers and form a seamless interface with the underlying native enamel. Results showed that P26 and P32 achieved controlled apatite crystal nucleation and size in solution, improved preferential orientation of apatite crystal formation, and promoted the formation of multilayered aprismatic crystals with desirable mechanical properties.The multilayered aprismatic crystals had greater hardness and elastic modulus than the demineralized enamel and formed in layers that grew in the absence of peptides. P32 differs

from P26 in the structural dimensions of peptide assemblies and crystal size it forms in vitro, but the two peptides achieve similar mechanical performance and crystal morphology. Their work on the discovery of functional domains within the amelogenin protein highlights opportunities to further improve the design of bioinspired peptides for tissue engineering and repair.

Underneath the crown's enamel, there is a layer of less mineralized, collagenous structure called dentin that also covers the tooth root. Due to its composition, the progress of caries is faster in the dentin and may increase the risk of irreversible dental diseases. Between the crown enamel and the root dentin, a boundary layer called the dentinoenamel junction (DEJ) provides a crack-arrest barrier that helps diminish the stress on the dentin. Mineralization of dentinal tubules is crucial for addressing dentin hypersensitivity. Non-carious cervical lesions, which can occur due to attrition, abrasion, abfraction, or erosion, are areas of damage to the exterior layer of protective enamel that can jeopardize the integrity of the tooth and the inner vascularized dentin-pulp complex. Therefore, there is an increasing interest in the restoration of the long-term health of teeth through addressing these lesions. As a natural extension of the capabilities of the synthetic peptide P26 in enamel regeneration, this peptide has been further investigated for its ability to regenerate both the enamel and dentin in cervical legions.

Dr. Moradian-Oldak's lab investigated the effects of P26 below the DEJ and examined the facets of dentin biomineralization through in vitro, in situ, and functional studies to understand the peptide's dentin biomineralization capabilities. Interactions between the enamel matrix protein amelogenin and collagen at the DEJ are crucial to preserving this vital junction. P26 interacts with collagen fibrils and promoted collagen mineralization in vitro and promotes dentin remineralization in situ. It also increases mineral density in enamel and promotes dentin tensile strength, in addition to restoring the hardness and elastic modulus of repaired superficial dentin. Dr. Moradian-Oldak's lab has shown that short peptides such as P26 have practical, financial, and clinical advantages over the use of full-length proteins in bioengineering. In dentistry, these findings hold therapeutic potential with clinical significance for the repair of lesions where both enamel and dentin are affected, such as non-carious cervical lesions. As these peptides have great potential, it is only a matter of time before bioengineered material will be available to replace conventional restorative materials.

Beyond research, Dr. Moradian-Oldak has inspired many students in positive ways by reminding us to pursue something we love and to remember the balance of family, work, and oneself.

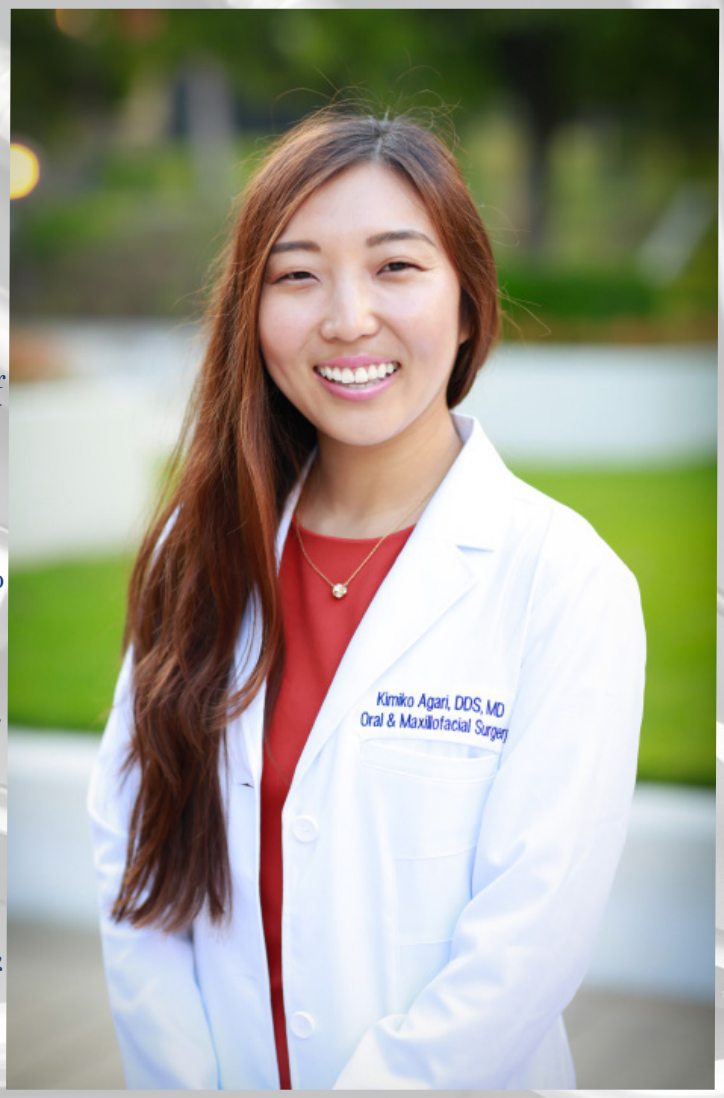
For instance, in the dental clinic setting, patients may receive a dental device, like a night guard for example, that holds a peptide-containing solution in place to promote enamel regrowth overnight instead of an invasive restorative procedure. Among Dr. Moradian-Oldak's many significant contributions to tooth mineralization research is this new class of therapeutic candidates that have obvious clinical significance. However, there are still challenges ahead that will need to be addressed before FDA approval, such as investigating application in vivo in the oral cavity.

Dr. Moradian-Oldak's lab continues to showcase promising findings that will help combat the high prevalence of tooth decay and further complications. In the future, Dr. Moradian-Oldak hopes to one day start clinical trials. Her ultimate goal is to have her research become translated to the clinical setting and help benefit patients with a non-invasive technique. Many people have expressed interest in Dr. Moradian-Oldak's work and support her immense contribution to the field of dentistry.

Beyond research, Dr. Moradian-Oldak has inspired many students in positive ways by reminding us to pursue something we love and to remember the balance of family, work, and oneself. She has mentored students who have now become successful leaders, educators, and clinicians, including USC faculty members. Flexibility, resilience, and strength are important skills she considers crucial for success and that she indeed embodies herself. With these admirable qualities, she will continue to thrive in her field of research.

Trailblazing Surgeon, Mentor, Researcher, and Hip-Hop Dancer

Ava Pournejad and William Chakar



Kimiko Agari, DDS, MD is a current 5th year resident in the Oral and Maxillofacial Surgery (OMFS) program at the University of Southern California. During her journey as a resident, she has excelled in providing patient care, mentoring students, and publishing research on novel topics in oral surgery.

Dr. Agari was born and raised in Stockton, California. From early childhood, she was drawn to the healthcare field. While exploring the different healthcare professions, Dr. Agari was particularly inspired by her own family dentist, who happened to be a close family friend. Her dentist's superb patient care and passion for the profession sparked her interest in pursuing a career in dentistry.

Dr. Agari started her undergraduate journey at the University of the Pacific, where she was admitted into the accelerated program pathway to dental school. She then attended the University of California, San Francisco for dental school. Upon the start of her dental education, Dr. Agari actively explored all the different specialties in dentistry. During her first year of dental school, she came across the opportunity to participate in an event by a student-led organization called Passing the Scalpel at UCSF, where she met inspiring mentors and peers who played a vital role in introducing her to the field of OMFS. This organization was founded by current USC OMFS chief residents, Allen Huang, DDS, MD, and Brian Lee, DDS, MD, along with their mentor, Stanley Liu, DDS, MD. Dr. Agari was remarkably inspired by the field of OMFS and the broad scope of practice that it entails. She networked and learned from all these encouraging mentors, which led her to pursue OMFS as a specialty.

Having experienced the tremendous impact that such an organization had on her journey into OMFS, Dr. Agari, along with the founders of Passing The Scalpel, Dr. Huang and Dr. Liu worked on their original research project, "Passing The Scalpel: A Student Initiative In Identifying and Addressing Unmet Needs In Dental Education," which was recently published in the Journal of Oral and Maxillofacial Surgery. This study has brought light onto the significant impact that this student-led organization has had on the success of young trainees interested in pursuing the field of OMFS. Recognizing the value of a student-led initiative, Dr. Agari believes that an organization of this nature can provide early exposure to OMFS, as well as networking and mentorship opportunities that would otherwise be difficult to find.

Dr. Agari also notes the unique opportunity she has to mentor and inspire females interested in oral surgery. When Dr. Agari first applied for OMFS, she knew this was a heavily male-dominated profession. For many women, this may seem overwhelming, but it did not discourage her from pursuing her passion. In light of her experiences, Dr. Kimiko Agari, along with her sister Dr. Kristi Agari, who is also a current resident in the USC Oral and Maxillofacial Surgery program, decided to start an organization called Sisters in OMFS through which they can provide support and mentorship to women pursuing a career in the field of OMFS.

Another one of Dr. Agari's original research work is her study "Successive Reimplantation of Dental Implants Into Sites of Previous Failure," published in the Journal of Oral and Maxillofacial Surgery which has been nominated for the 2020 Journal of Oral and Maxillofacial Surgery Best Paper Award. With dental implants being one of the best, most evolving treatment options for restoring edentulous spaces, Dr. Agari's work plays an invaluable role in identifying factors that may lead to reimplantation failures. Along with her faculty mentor, Bach Le, DDS, MD, Dr. Agari investigated site-specific, patient-specific, and implant-specific factors in patients with implant and reimplant failures. Some key observations were consecutively lower survival rates with successive reimplantations into the same site, as well as a significantly greater percentage of postoperative pain and a significantly greater percentage of early implant failures (failure prior to abutment connection) in implants and reimplants that failed. Their recommendations for clinicians are to closely monitor for postoperative pain after implant or reimplant placement and use it as a possible predictor of implant failure. If postoperative pain is noted, clinicians may intervene with more aggressive postoperative management, whether that be closer follow-up visits, more frequent postoperative imaging, or postoperative antibiotics. Clinicians may also educate their patients with the likelihood that if they have reached the point of abutment connection, their risk of implant failure becomes much lower.

Table 4. FAILURE RATES FOR ALL IMPLANT GROUPS STRATIFIED BY FAILURE TIMING

Implant Failure	n/N (%)
Initial	
Early	211/252 (84)
Late	41/252 (16)
First reimplantation	
Early	36/40 (90)
Late	4/40 (10)
Second reimplantation	
Early	6/6 (100)
Late	0/6 (0)
Third reimplantation	
Early	1/1 (100)
Late	0/1 (0)

Agari and Le. Reimplantation of Dental Implants After Failure. J Oral Maxillofac Surg 2020.

As an OMFS resident, Dr. Agari has rotated through the Children's Hospital of Los Angeles (CHLA), where she has had the unique opportunity to care for pediatric patients and learn from craniofacial surgery attendings and mentors Mark Urata, DDS, MD, and Jeffrey Hammoudeh, DDS, MD. This experience inspired new research projects and an affinity for pediatric care. Dr. Agari is continuing the research work of her chief resident, Dr. Allen Huang, in pediatric craniofacial anomalies requiring mandibular distraction. Mandibular distraction is the novel technique of lengthening the mandible for patients with congenital and developmental micrognathia, such as Pierre Robin Sequence. A major advantage of this procedure is the ability to improve these patients' airways and avoid the need for tracheostomy. Dr. Agari's research, guided by faculty mentor Dr. Hammoudeh, aims to investigate and characterize the timeline of relapse for these patients who have undergone mandibular distraction, as well as compare the differences in relapse between males and females.

Following the completion of her residency program, Dr. Agari plans to remain involved in the academic world to both teach and provide patient care. She enjoys teaching and mentoring, a trait she attributes to both her parents being teachers. She particularly enjoys pediatric oral surgery and craniofacial care and would like to continue her contributions to this field. In her free time, Dr. Agari takes advantage of LA's weather and diverse opportunities, participating in activities such as skateboarding, snowboarding, hot yoga, spending time at the beach, and, most recently, hip-hop dance classes.

Dr. Kimiko Agari is an accomplished surgeon, academic, researcher, and mentor, and we wish her the best in her promising future. Fight On!

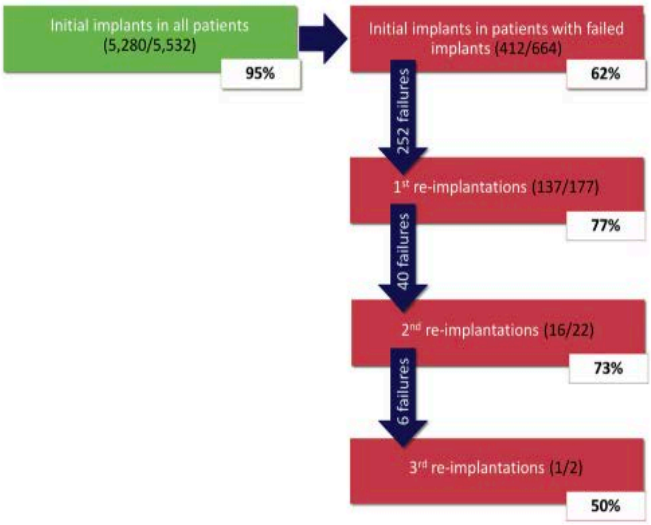


FIGURE 1. Survival rates of each implant and reimplant group from January 2010 to May 2017. The *initial arrow* (from the *green bar* to the *red bar*) compares the survival rate of implants placed in all patients during the study period with the survival rate of all implants placed in any patient with at least 1 failed implant. The subsequent *red bars* depict the survival rates of the consecutive reimplantation groups.

Agari and Le. Reimplantation of Dental Implants After Failure. J Oral Maxillofac Surg 2020.

New Frontiers in **Orofacial Pain** and **Medicine**

Sam Sheridan and Antranig Mesrobian

"Dentistry has always had an influence on my life…. The dental clinic is different, and I've always loved the sound of the drill. I knew I wanted to be a dentist one day" Dr. Kamal Al-Eryani was only seventeen years old when he embarked on his dream and first enrolled as a dental student in the well-recognized Damascus University after graduating from high school in Yemen.

As an Assistant Professor of Clinical Dentistry within the Orofacial Pain and Medicine Center at the Herman Ostrow School of Dentistry of USC, Dr. Al-Eryani continues to remain active on multiple research projects. He currently teaches online courses about oral medicine, supervises dental students during their rotation in Orofacial Pain and Medicine, and spends much of his time working with and helping to mentor residents and master's students.

Early Influences

Dr. Al-Eryani's journey to USC evolved over many years. Following his graduation from Damascus University in 2001, he initially returned to Yemen to work as a clinical instructor in a university Oral Surgery department for almost three years. It was there that he was introduced to one of his most influential mentors, Dr. Takashi Saku. Dr. Saku was interested in studying the oral chewing habits associated with cancer, and he visited Yemen to study this alongside Dr. Al-Eryani. This early exposure to research motivated Dr. Al-Eryani to continue his education by enrolling at Niigata University in Japan to pursue his PhD in Dental Science while working alongside Dr. Saku. They continued to study and publish their work on the invasion and proliferation of specific lines of oral carcinoma, with the goal of finding effective clinical measures to reduce the growth of oral cancer.

Following the completion of his PhD program, Dr. Al-Eryani returned to his homeland of Yemen and was ultimately named the Head of the Department of Oral Medicine, Pathology, Radiology, and Periodontology at Sana'a University. He quickly noticed a high prevalence of temporomandibular joint disorders associated with the chewing of khat, which is a central nervous system stimulant found in the leaves of a wild shrub called *Catha edulis*. This trend motivated him to start learning from the numerous publications by Dr. Glenn Clark on the subject. Ultimately, this newfound interest and passion for learning more about temporomandibular joint problems opened the conversation between him and Dr. Clark, and soon Dr. Al-Eryani applied and was accepted to join the Orofacial Pain and Medicine program at USC.

Dr. Al-Eryani's passion for teaching and research continued to develop, and he was soon hired as an Assistant Professor of Clinical Dentistry in the Orofacial Pain and Medicine Center at USC after completing his post-doctorate education. Upon reflection, Dr. Al-Eryani states, "My passion is to sit with students and teach them. I feel happy when I get feedback from students and hearing that they learned something… This is the best reward that a teacher can have."

Current Research

Dr. Al-Eryani is driven by a strong desire to contribute to the field of dentistry through innovation and collaboration. His research studies span a wide array of topics, from oral squamous cell carcinoma to temporomandibular joint disorder in bisphosphonate users. A recent publication titled "Modified protocol including topical minocycline in Orabase to manage medication-related osteonecrosis of the jaw cases" proved to be especially significant due to its clinical application of an alternative treatment option for patients

who have been diagnosed with medication-related osteonecrosis of the jaw (MRONJ). MRONJ is a severe adverse drug reaction that leads to progressive bone destruction in the maxillofacial region. The pharmacological agents which can lead to this debilitating condition include antiresorptives (such as bisphosphonates and RANKL inhibitors) and antiangiogenics.

The American Association of Oral and Maxillofacial Surgeons (AAOMS) classifies individuals with MRONJ as those who (I) do not have a history of radiation therapy or manifest metastasis to the jaw; (II) have a history of ongoing or antecedent treatment with antiangiogenic or antiresorptive drugs; and (III) experience exposed bone or presence of an intraoral or extraoral fistula in the maxillofacial region persisting for more than eight weeks. The current treatment protocol as set forth by the AAOMS is to control the infection through the use of systemic antibiotics and surgical debridement, provide pain management, and prescribe chlorhexidine rinses to maintain the oral microbiome.

Dr. Al-Eryani's study assessed patients who were unresponsive to the established protocol and applied 10% topical minocycline in an effort to improve patient outcomes. Minocycline is a broad-spectrum antibiotic with anti-inflammatory properties and the ability to stimulate osteoblasts, which can increase bone matrix formation. Additionally, minocycline has the ability to bind bone more than any other antibiotic and maintains therapeutic levels in affected bone for a prolonged period of time. Topical minocycline has demonstrated advantages over systemic antibiotics, which exhibit low penetration into the ischemic and necrotic bone tissue and present the risk of systemic toxicity with long-term use.

The participants in the study were initially treated based on the guidelines set forth by the AAOMS. Participants who were unresponsive to the initial treatment were then enrolled in the research study and treated weekly with 10% topical minocycline alongside surgical debridement and chlorhexidine irrigation. The results proved beneficial, as all patients reported pain relief after the first treatment with minocycline. Furthermore, some patients saw complete healing within a few weeks of starting the protocol and showed bone regeneration at the three-month follow up. These important results suggest further evaluation of 10% topical minocycline is warranted as an addition to the treatment protocol of patients who suffer from MRONJ and could offer patients a superior treatment option.

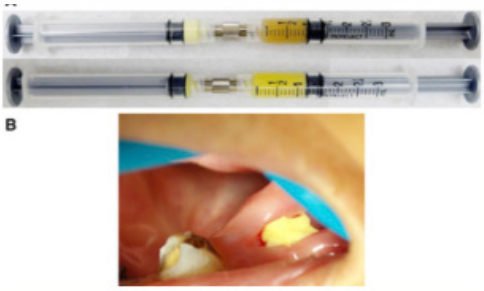


Figure 1: Topical minocycline compounding and use. (A) The upper left syringe contains 100 mg minocycline powder and the upper right syringe contains 1 gm of Orabase measured in the scale, and the two syringes connected by female/female connector. 10% minocycline paste is compounded by mixing the powder and Orabase forward and backward from one tube to another until the mixture is completely homogenous. (B) Applying the compounded topical minocycline into the bony defect.

Dr. Al-Eryani's relentless desire to learn more and add to the current body of knowledge persists, which is evident in each of the research projects he is currently working on. These include the management of post-implant neuropathic pain, the prevalence of ear-related symptoms in temporomandibular joint (TMJ) disorder patients, a review of the use of stem cells in TMJ regeneration, and a review on lichen planus diagnosis and treatment. Dr. Al-Eryani reminds us all that the purpose of research is "not just to publish your name… it is how you could add something valuable to the scientific community." He has continued to help propel the scientific community forward and plans to continue to build on these many findings he's already achieved.

Alongside his clinical research, Dr. Al-Eryani remains at the forefront of patient care and management. With Dr. Glenn Clark, Dr. Al-Eryani is currently working on a software platform that utilizes artificial intelligence to assess patient complaints and provide a preliminary diagnosis. In the coming years, this screening tool will prove useful in streamlining how clinicians diagnose and treat their patients. It is this forward-thinking vision that makes Dr. Al-Eryani an instrumental member of the USC Orofacial Pain and Medicine Center.

What Does the Future Hold?

Dr. Al-Eryani continues to display the willingness and enthusiasm to learn, educate, discover, and inspire. His humble demeanor speaks volumes about his character. When asked about the future, his outlook is quite simple: continue researching, continue educating, and continue contributing to the betterment of dentistry.

Dr. Al-Eryani's passion for his work carries over into how he goes about his personal life. Whether it is spending time with his family or pursuing other interests, he reminds us that a proper work-life balance is crucial: life is meant to be enjoyed in all aspects. With the COVID-19 pandemic tearing through the world, Dr. Al-Eryani's words of wisdom ring true now more than ever before. Time may contextualize life, but the very essence of life is determined by the manner in which it is enjoyed. "Happiness is of the utmost importance…it lies in one's passions. Spend your lives with joy and happiness, and always remember to smile!"

Dr. Al-Eryani in the white coat with the endodontic residents at the Universidad Catolica de Honduras.

Dentures Go Digital

Emilie Hsu and Greg Park

Dr. Fabiana Varjao is a researcher and Clinical Associate Professor in the Division of Periodontology, Diagnostic Services, & Dental Hygiene at the Herman Ostrow School of Dentistry of USC. She has published a plethora of publications focused on denture selection methods that promote both esthetics and function in the clinical applications of both conventional and digitally designed dentures. Dr. Varjao has been recognized with multiple teaching awards, including the Teacher of the Year Award by the Pierre Fauchard Academy, a renowned international honorary dental organization whose mission is to recognize and grow leaders in the dental profession, their communities and society.

Research has been a longstanding pillar in Dr. Varjao's education and career. Her interest in research began when she was selected as a scholarship student to conduct adhesive testing studies in the field of operative dentistry during her first year in dental school at the São Paulo State University in São Paulo, Brazil. As she continued with research during her second year, Dr. Varjao undertook her first denture research project where she explored the methods and materials of creating an esthetic denture to emulate natural anatomy and function. This particular experience helped Dr. Varjao discover her true passion within removable prosthodontics and set the foundation for her current research is on complete dentures. After receiving her Doctor of Dental Surgery degree, Dr. Varjao pursued her Master's degree and PhD in oral rehabilitation also at the São Paulo State University. Since then, she has remained in close contact with faculty members in the field of prosthodontics and has pursued additional fellowships to direct her research projects on fixed and removable prosthodontics.

Dr. Varjao has published over 30 papers in peer-reviewed journals on her clinical research. Her current research investigates methods of selecting teeth to maximize esthetics and function in dentures. Seeing a disconnect between previous studies that have guided current tooth selection practices and actual clinical results with patient satisfaction, Dr. Varjao's current research unravels optimum selection methods across different ethnicities. Previous research had primarily been conducted using white/caucasian populations as their sample group, so Dr. Varjao wanted to explore whether more inclusive studies could produce better outcomes for diverse patients.

What she found is that there are in fact anatomical differences that can help improve outcomes relative to traditionally used methods. "For example, there is one guideline suggested and utilized in the clinic which is measuring the width of the nose corresponding to the two canine tips, a distance representing how wide those teeth would be. The same method for African Americans simply wouldn't work because of differences in overall composition of the patients in different ethnic groups." Using the traditional method of selecting tooth width by measuring the width of the nose to correspond to the width of the canine tips can create a smile with teeth that are too big or too small. Another example is the golden ratio for tooth height versus width. Nobody in the dental field is unfamiliar with this ratio, but many are unfamiliar with the fact that it is not universal across ethnic groups. Dr. Varjao's research shows that although the golden ratio may hold true for Asians and Caucasians, it can be unhelpful when treating African Americans, for whom a ratio closer to 90% may yield more natural aesthetics. Through Dr. Varjao's controlled clinical studies, she devised 14 methods to select teeth to better accommodate tooth differences between

different ethnic groups. She explained that with this new discovery, we can and should apply this knowledge to our clinical practice to provide more personalized care for our patients and increase patient satisfaction, which will help patients feel more confident with their new appliances.

Another area of Dr. Varjao's research is studying the advantages and applicability of digital dentistry in removable prosthodontics. Realizing that the future of dentistry is steadfastly heading towards digital tools, together with Dr. Tae Kim, Dr. Varjao led the digital transformation of removable prosthodontics at the Ostrow School. In her research, she has found that "digital dentures made with CAD/CAM technology eliminate many human errors, so they have a superior fit and comfort." For example, because digitally printed dentures are fabricated by simultaneously laying and curing resin layer-by-layer, distortion is reduced, allowing for a better fit.

An additional benefit, as well as a clinical implication of research on digital dentures, is that chairside time is significantly reduced. When the patient comes in, the scan is done digitally, and while the patient waits in the clinic, information is sent to the lab where dentures can be created. For final complete dentures, this can translate into just 2-3 appointments needed from the start of the scan to the delivery of the denture. It is also even possible to deliver interim dentures to patients in just one day, making an immediate impact on their quality of life.

Dr. Varjao understands that there is space and necessity for digital dentistry within removable prosthodontics, but also wants to ensure that the dental community is well-equipped to provide optimal results with the new technology. Digital dentistry is not a new concept, but there is a definite lag within the field of removable prosthodontics in the adoption of these new technologies. That is why Dr. Varjao is directing her research now to digital dentures, so that she can help promote the dental community in "making sure what's available today [in digital dentistry] will fulfill [both] function and esthetics of teeth."

Dr. Varjao also shared one of her challenges as a researcher, namely finding a sufficient number of volunteers for her clinical research. Clinical studies are crucial, and even more important is making sure that the study participants reflect the diversity of the population at large in a representative fashion. Says Dr. Varjao, "[In clinical studies] the criteria for inclusion and exclusion are very specific [to represent the population without bias]. And finding enough people is a big challenge."

Because she is studying the differences in natural anatomy across many ethnic groups, she requires patients aged 18 to 40 years old who have fully intact dentition, which means that they have never worn braces and have no restorations or crowns. In her study, it is a huge challenge to search for 100 subjects that fit her criteria, but "if you only collect data from 10 people, it does not represent the whole population. In addition, volunteers and researchers as well as subjects should also show up for appointments and be committed to that study, which does not always work as planned," says Dr. Varjao.

She also finds that sometimes clinical practices and dental manufacturers tend to lag behind new knowledge and developments found in research. For example, although we now know that facial measurements do not always correspond accurately to the teeth shape and size across all ethnicities, it is still a widely used method for tooth selection. Although we know that tooth size, shape, and shade can vary widely, not many manufacturers carry options outside a relatively narrow range. But Dr. Varjao explains that this is not something that should discourage us; instead, she encourages building awareness of new developments by publishing research. According to Dr. Varjao, "it's nothing if you don't publish your research."

While talking to Dr. Varjao about her research, her passion and love for what she does in the clinic is quite palpable. She explains that with a research background, she can apply all of her scientific and evidence-based knowledge to a clinical setting, which is quite exciting. She considers a patient's gratitude, smile, and happiness to be the most satisfying for her as a researcher and clinician.

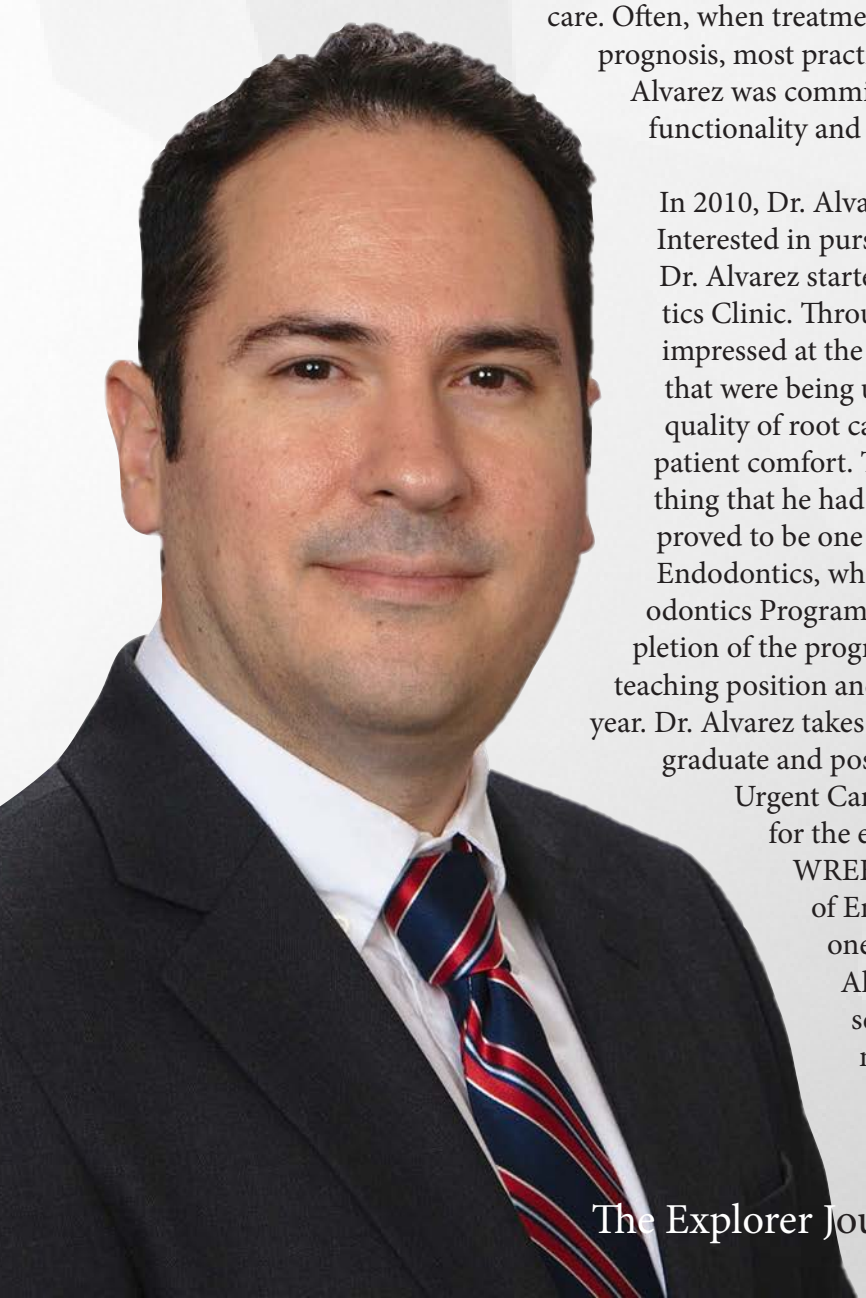
Dr. Varjao tells students who aren't sure that research is what they want to do in the future, "If you're not sure if this is what you're going to do, try it first. Take the opportunity as much as possible. Look for a mentor with research experience. Try it, but it takes a lot of effort and commitment. It is difficult to find someone who balances clinical and research, but the fact that what I have studied can be applied to the clinic and to the patients is why I am greatly passionate about research."

Dr. Varjao appreciated having great mentors who guided her and confirmed her passion for research and removable dentures. "The more I did," she recalls, "the more I wanted to do." It is clear that she will continue to thrive in teaching students, educating patients, and continuing her passion for complete dentures.

Acute Pain Management and Preventive Dentistry *in Endodontics*

George Simonyan and Abraham Zilberstein

Dr. Mario Alvarez has always strived to relieve patients from their pain and preserve their natural teeth. Born and raised in Honduras, Dr. Alvarez graduated from the Universidad Nacional Autonoma de Honduras with a D.D.S. degree in 2004. Following his graduation, Dr. Alvarez was able to fulfill his passion for helping communities in need by working as the lead dentist at an Episcopal Church Dental Clinic. Working solely with underserved communities, Dr. Alvarez was able to experience first-hand how these patients had severe oral health problems due to their inadequate access to dental care. Often, when treatment planning many teeth with guarded and poor prognosis, most practitioners would turn to extracting teeth – but Dr. Alvarez was committed to conserving natural teeth to maintain functionality and longevity by performing root canal therapy.



In 2010, Dr. Alvarez, along with his wife, moved to California. Interested in pursuing more in-depth exploration of endodontics, Dr. Alvarez started shadowing in the USC Advanced Endodontics Clinic. Throughout his time shadowing, Dr. Alvarez was impressed at the microscopes and rotary endodontic instruments that were being used, which not only improved the outcome and quality of root canal procedures but also increased efficiency and patient comfort. These techniques and instruments were something that he had not been exposed to in Honduras, and they proved to be one of the driving factors, along with his passion for Endodontics, which made him apply to USC's Advanced Endodontics Program, to which he was accepted in 2012. Upon completion of the program in 2014, Dr. Alvarez undertook a part-time teaching position and recently became full-time faculty in the past year. Dr. Alvarez takes pride in being able to mentor and teach undergraduate and postgraduate students, in addition to working in the Urgent Care clinic a few days a week and preparing students for the endodontics portion of licensure exams for the WREB and ADEX. As important as the clinical aspect of Endodontics, treatment planning and choosing one procedure over another relies on research. Dr. Alvarez is currently involved in two clinical research projects, one that is aimed at exploring the management of endodontic pain and another with the goal of preventing dental caries before it can arise.

In endodontics, successful management of acute pain is essential. Often, dental emergencies and dental pain are of endodontic origin, and being able to manage this pain appropriately plays an important role in patient compliance and the outcome of the procedure. Therefore, endodontists must often address the problem of odontalgia before being able to render appropriate therapy. Local anesthesia via common anesthetics not only allows the dentist to perform treatment but can also help reduce odontalgia – but this does not always address the pain effectively. To dig more in-depth into pain management, Dr. Alvarez and Dr. Ramon Roges are running a clinical study on the effectiveness of infiltration (periapical) injection of ketorolac tromethamine (Toradol) for the management of endodontic pain. Toradol is the first non-steroidal anti-inflammatory drug (NSAID) that is available for periapical infiltration and intramuscular injection. Endodontic pain is linked to the inflammatory process that results from the stimulation of nociceptors as well as additional central mechanisms. Irritation of the dental pulp produced by bacteria, mechanical stimuli, or chemical stimuli can cause inflammation. These stimuli can cause the enzymatic conversion of arachidonic acid in biologically active group mediators such as leukotrienes, PGs, and thromboxane acid, and many others. Similar to most NSAIDs, Toradol can combat inflammation and pain by competitively inhibiting the cyclooxygenase (COX) enzyme, thus inhibiting prostaglandin synthesis. With the application of Toradol via periapical infiltration, Dr. Alvarez and Dr. Roges hope to find an effective way to manage endodontic pain that will have a profound effect on treatment outcomes.

Sodium hypochlorite rinsing exerts broad antimicrobial activity against experimental oral biofilms and has demonstrated substantial results including a 48% reduction in Plaque Index (PI) score, 52% reduction in Gingival Index score, and 39% reduction in bleeding from probing sites. Furthermore, sodium hypochlorite can also penetrate into and potentially kill cariogenic bacteria within dentinal tubules; in a study by Galvan et. al, it was found that rinsing with a 0.25% sodium hypochlorite twice weekly caused a 94% greater reduction in dental plaque mass than water-rinsing.
The treatment protocol being investigated by the team proposes a twice-weekly oral rinse for 30 seconds with 0.1% sodium hypochlorite for the prevention of dental caries. The study will be conducted at local schools in Honduras and include 80 otherwise healthy 5-year-old children, with the duration of the study lasting for approximately 1.5 years. Forty children will be assigned to the sodium hypochlorite group, and the other 40 children will be assigned to the control group that will be rinsing with tea. The baseline visit will include a clinical assessment of caries and a general oral examination, microbiological sampling of whole stimulated saliva to be stored and analyzed, and recording of the child's DMFT caries. At the end of the clinical study, the salivary samples will be examined for levels of S. mutans and lactobacilli using established real-time PCR protocols, in addition to a second DMFT index to compare to the pre-trial baseline. The proposed trial hopes to establish this rinsing protocol as highly safe, minimally invasive, practical, and inexpensive antimicrobial therapy for the prevention of dental caries. Dr.

Being an oral health advocate and a mentor for students in endodontics, Dr. Alvarez hopes to keep helping students appreciate the specialty of endodontics while focusing on making a difference in the world through his clinical research.

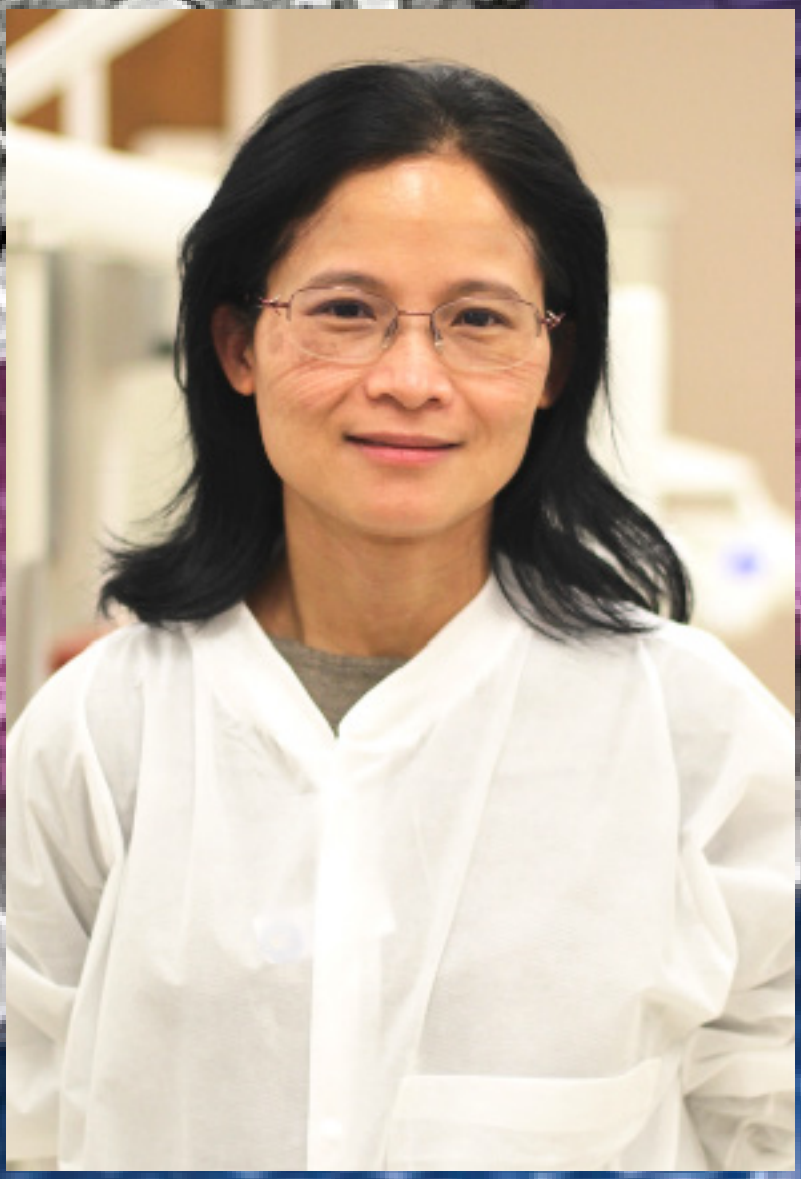
Worldwide, dental caries is one of the most common chronic diseases of childhood and is particularly prevalent in people living in poverty and those with poor oral hygiene. Caries prevention includes regular cleaning of teeth, a diet low in sugar, and fluoride treatment. In developing countries, infrequent dental check-ups, lack of oral hygiene education, and lack of proper oral hygiene tools such as a toothbrush and toothpaste have led to a rapid increase in caries in children. Dr. Alvarez, along with Dr. Ramon Roges, Dr. Rafael Roges, and Dr. Jorgen Slots, is trying to reduce the prevalence of caries in children by utilizing a powerful and cost-effective approach – diluted sodium hypochlorite rinses. Sodium hypochlorite has been used as an antiseptic agent in dentistry for more than a century and remains a widely used root canal irrigant at concentrations of 1.0-5.25%.

Alvarez is optimistic about the potential feasibility of a diluted sodium hypochlorite rinse being implemented in virtually all parts of the world using low-cost local resources.

Being an oral health advocate and a mentor for students in endodontics, Dr. Alvarez hopes to keep helping students appreciate the specialty of endodontics while focusing on making a difference in the world through his clinical research. He plans to continue visiting Honduras frequently throughout his career to provide dental treatment to communities in need, while inspiring the children of Honduras to pursue their career goals, just like his community inspired him during his time at the Episcopal Church Dental Clinic.

Pathway to Periodontology

Fan Xu and Sarina Taylor



Dr. Naomi Nguyen, DDS, MS, is a periodontist and an Assistant Professor of Clinical Dentistry at the Herman Ostrow School of Dentistry of USC. In addition, she is a part-time faculty recruiter for the Periodontology program, a guest lecturer for both DDS and dental hygiene students, as well as a volunteer dentist for CDA Cares mobile clinics. Dr. Nguyen has come a long way since she moved from Vietnam to the United States as a teenager. Faced with a language barrier, she started her American education in an ESL program and diligently worked her way toward undergraduate education at California State University - Long Beach. It was there that she first realized her interest in dentistry. She recalled with amusement that the prospect of working in dentistry was introduced to her through a career assessment test, which recommended her to be either a janitor, a mechanic, or a dentist. Out of those three options she was most drawn to dentistry. The reasons for which she felt this pull subsequently began to manifest. During Dr. Nguyen's gap years after college, she demonstrated two essential strengths needed to become a great clinician: altruism and an interest in science-based research.

With her biochemistry background, Dr. Nguyen worked for two biotechnology companies before dental school. She first participated in research on type 1 diabetes that focused on creat-

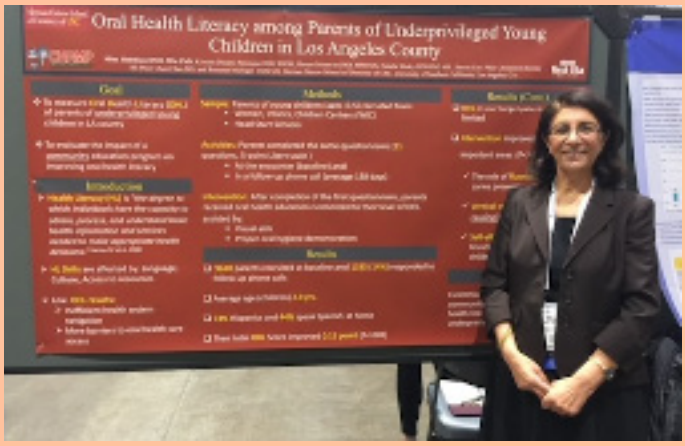
ing devices to encapsulate the islet of Langerhans cells so that they could be transplanted into diabetic patients. She then joined the research team for a clinical study on the use of porcine blood vessels to bypass human cardiac arteries. This technique was already approved in Europe, and her team was working towards FDA approval. In addition to her research, Dr. Nguyen was also a frontline Red Cross volunteer for three years. As a member of the Red Cross AmeriCorps, she provided disaster relief to underserved communities affected by natural disasters through arranging food, clothing, and housing for the families. In particular, she was a part of the National Rapid Response Corps, which deployed her to Oklahoma for flood response. Not only was she trained extensively in emergency management, Dr. Nguyen also became a CPR instructor at Red Cross.

After gaining substantial research and volunteer experience, Dr. Nguyen pursued her dental aspirations at UCLA School of Dentistry. She frankly noted that her initial clinical experience with periodontology may be relatable to many dental students: she wanted to do more operative procedures instead of basic, non-surgical periodontal treatments. However, she became motivated to further her education in periodontology due to a personal experience with the field. Dr. Nguyen was diagnosed with periodontal disease in college by a general dentist, who in retrospect probed too aggressively and over-diagnosed her. She was then referred to a periodontist, only to have a more unsatisfactory experience and severe postoperative pain for weeks. Nonetheless, this rather traumatizing experience was a blessing in disguise. From the unpleasant dental visits, Dr. Nguyen began to appreciate the importance of plaque control and management of periodontal diseases.

After achieving her DDS degree, Dr. Nguyen soon started her Periodontal Residency at University of Nebraska Medical Center College of Dentistry. There, she not only refined her periodontal surgical skills, but also completed a Master of Science degree in Oral Biology, studying the potential use of diode lasers in periodontal therapy. Following the completion of her residency, Dr. Nguyen returned home to Southern California where she started her career as an educator at USC. Before dental school, teaching had played an important part of her life, as she was a teaching assistant during her undergraduate studies for a variety of courses including math, biology, and French, not to mention her time as a CPR instructor when she was a part of the American Red Cross. Furthermore, her enthusiasm for the prospect of working at the Herman Ostrow School of Dentistry of USC due to its exceptional reputation inspired her to make a natural transition to education. Given her rich background as an educator, it is no surprise that Dr. Nguyen is excelling as a Clinical Assistant Professor.

When asked to give a few words of advice to current dental students, Dr. Nguyen noted the importance of understanding periodontology in order to provide patients with proper care. She understands that students may be initially more excited by the operative procedures, as she once was, but encourages us to value periodontology as a fundamental component of patient care and a key tool in conserving teeth. Dr. Nguyen further noted that in her experience, appreciation for the basic science behind treatment as well as a genuine passion for helping people are the cornerstones of a successful career in dentistry. As exemplified by her research involvement, community service, and dedication to education, Dr. Nguyen has proven to be a role model for future dentists and an example of how to achieve one's goals through diligence and passion.

Ostrow's CHAMPion of Dental Public Health



Parinaz Esteghamat Tehrani and Isatu Malekani

"Life is not a straight path; sometimes there are obstacles and opportunities that get thrown at you," says Dr. Mina Habibian. Her journey to the Herman Ostrow School of Dentistry of USC involved many such twists and turns. Dr. Habibian is a board-certified public health dentist. She started her research career in dental public health in 1991 at the University of London, where she pursued her Master's degree and PhD, worked as a Research Fellow, and published in peer-reviewed journals. When asked about the differences between practicing dentistry in the United Kingdom and the United States, Dr. Habibian notes that the practical evidence and health care delivery are not any different. However, the United Kingdom has a unique national health care system, in which children are given full dental coverage until age 18, in contrast to the very different system in the United States.

Dr. Habibian moved from the United Kingdom to join her husband, who got a job opportunity in San Diego, once her older child finished high school. After her move, she knew that she wanted to find her way into academia. She was drawn to USC due to its extensive public health program, and she was hired as a part-time Clinical Assistant Professor in 2001. At the same time, while commuting from San Diego to Los Angeles, Dr. Habibian successfully managed to build up her own private practice in San Diego from scratch. After almost two decades, Dr. Habibian sold her private practice in 2019, and she joined USC as a full-time Associate Professor of Clinical Dentistry. When asked how she was able to balance practice ownership, academia, and motherhood, she stated, "It wasn't easy raising two children, emigrating to California, and having an academic job. But it worked really well for all of us, especially my husband being a young professional who travels a lot and works hard, so I had to be in town taking care of my children. Somehow it worked with a little bit of luck and time management."

At USC, Dr. Habibian's passion for oral public health led her to create an online master's degree program in Community Oral Health, which she currently continues to direct. "Since many communities face socioeconomic problems, we need to train dental graduates to become knowledgeable in social determinants of health, assessing the communities' needs, and ultimately be community health soldiers." The mission of the online program is to serve as a grassroots organization, training professionals with skills that they need to prevent disease. The master's program is open to graduate students from a wide variety of academic backgrounds who meet the USC master's degree program's minimum requirements.

Dr. Habibian has extensive formal training in the public health field, including a PhD in dental public health. Dr. Habibian's PhD thesis was on the etiology of early childhood caries, and analyzed a prospective cohort study that investigated the behavioral, microbiological and socioeconomic risk factors involved in the initiation of early childhood caries. At the time of its publication, her work was the first comprehensive study that applied a prospective research methodology to this topic. Dr. Habibian's interest in public health research has inspired her to apply her knowledge and skills to a wide variety of research topics. One of the issues of great concern in public health is lack of access to healthcare; in the US, it is perhaps the homeless population that suffers from this the most. In a study titled "Dental students' attitudes toward homeless people while providing oral health care," Dr. Habibian and colleagues questioned the conventional wisdom that health care providers' negative attitudes toward

homeless people may be a reason for lack of access to healthcare services. The researchers aimed to analyze dental students' attitudes before and after they attended rotations once per week at the USC Union Rescue Mission Dental Clinic, which provides comprehensive dental services to homeless patients. A total of 242 students completed questionnaires before and after the rotation. Data collected over the course of two years revealed that students had positive attitudes towards the homeless population even prior to the rotation. What's more, 85% of students agreed that the rotation made them feel more comfortable treating homeless patients, and 98% agreed that the patients made their experience enjoyable. These findings suggest that participating in such programs can provide future care providers with experience that helps them become more comfortable giving much-needed care to this important underprivileged and underserved population.

In addition to providing dental services to the underprivileged populations in the community service clinics, USC DDS students take a Behavioral Dentistry module which is designed to teach future dental professionals about multiculturalism, cultural issues, health literacy, and different ways to address patients' unique needs. This way, the students can have a better understanding of different populations' health care issues as well as develop appreciation for patient-centered care.

Dr. Habibian has recently been involved in two major community programs, the Children's Health and Maintenance Program (CHAMP) and the Education Community Health Outreach (ECHO) program. Dr. Habibian led the creation of CHAMP, which focused promoting the importance of maintaining good oral health to young children. The CHAMP program, targeted a cohort of 45,000 underprivileged children and families in Los Angeles County, between 2012 and 2018. The project had several components, one of which had an emphasis on community education. The goal was to provide parents with training on how to handle their children's oral health. Dr. Habibian led the professional education component of the program, which was directed towards dental and medical staff, on the importance of referring children with oral health needs to dental offices. The research arm of the program was a randomized clinical trial (RCT) that enrolled children and families into one or more motivational interventions, which included use of an intra-oral camera and/or social work consultation, in the hopes of improving subsequent scheduling of dental appointments. The RCT showed that children who were given both interventions were four times more likely to schedule appointments by their second follow-up compared to those in the control group. The program successfully concluded that outreach health promotion programs are inherently important, and that the use of multiple motivational techniques is critical in encouraging children and their families to enroll and seek treatment at dental homes.

Building on CHAMP, Dr. Habibian furthered related research with the ECHO program, which was established in 2017. The ECHO program is one of several local dental pilot projects funded through the California Department of Health, and represents a partnership between USC and California State University LA. The goal of ECHO is to provide dental homes for children, through means of professional education, community education, and screening. The program provides oral health screenings, personalized oral health education for children and families, and referrals to dental homes.

Dr. Habibian's research with Dr. Roseann Mulligan and colleagues published in the Journal of the California Dental Association, "Mobile Dental Clinic: an oral health care delivery model for underserved migrant children," revealed rates of untreated decay to be as high as 87.4% in children in underserved communities. This research was completed prior to the COVID-19 pandemic in 2020, which is expected to have many lasting implications that will do particular harm to underserved communities. As many community health outreach programs have been put on hold due to the severity of the COVID-19 pandemic, Dr. Habibian is highly concerned about the impact that this will have on vulnerable populations across Los Angeles. She described different barriers to care that are currently faced by people within susceptible populations, which include dire financial status, limited access to transportation, and clinics working restricted hours at reduced capacity. As the effects of the pandemic continue to unfold, Dr. Habibian will continue to be a champion for our local underserved communities.

Dr. Mina Habibian is a passionate, committed, innovative, and diligent individual whose mission is to train future dental professionals and make a meaningful contribution to the dental community. Her endeavors in research and her contribution to the community are quite admirable and set a great example for future dentists. Her success story should inspire all of us in the dental professions to focus on community-minded, patient-centered care.

Brightening Smiles through Community Dentistry

Christie Shen and Michael Debourg II

Whether it be out of necessity or elective choice, visiting the dentist has become routine for much of our society. While many of us book our next appointments for whitening, porcelain veneers or the latest Invisalign, others may consider dentistry a luxury, or in some cases, even an impossibility. What happens to the oral health of those who do not have access to care? What do you tell the parents of a child who cannot find a dentist within a three-hour radius who would agree to see their child despite the family's finances? These are some of the questions that have led Dr. Sanaz Fereshteh, affectionately known as "Dr. Sunny," to forge a path which translates her technical skill and expertise into solutions for those in desperate need.

The story of Dr. Sunny's unwavering passion for public health dentistry started at a very young age. After receiving her bachelor's degree in chemistry from Dickinson College in Pennsylvania, Dr. Sunny worked in Boston as a hospital chemistry technician. She was first inspired to pursue a life of service through the actions of her mother, who ran a Head Start program in Pennsylvania while she was growing up. The stories she heard from her mother about underserved communities lit a fire in her that would only begin to burn brighter from that point on.

During her first mobile clinic externship to San Luis Obispo while attending the Herman Ostrow School of Dentistry of USC, she was so motivated by the things she saw that she pleaded for a job there even before she graduated. As luck would have it, she was offered a position. Dr. Sunny went on to gain some of her most pivotal experiences during the next five years while working at the federally qualified health clinic (FQHC). In treating and changing the lives of hundreds of families, she came to a deeper understanding of how these clinics are run and what their limitations are.

The tension between the breadth of preventative care that Dr. Sunny wished to provide and the large portion of funding for FQHCs that went toward restorative care was striking to her. These issues weighing on her mind became visible to one of her closest mentors, Dr. Gardner Beale, during one of her volunteer days at the mobile clinic. After a heartfelt conversation filled with encouraging words and wisdom with Dr. Beale, Dr. Sunny set out on a new path, one that would turn her focus toward a deeper commitment to the mobile clinic and her roots in public health dentistry.

Dr. Sunny's passion for service has been evident to all who have had the pleasure of making her acquaintance. Her passion is clearly contagious, as she was selected for multiple appointments within USC's renowned Mobile Clinic from her start as a volunteer to becoming Co-director, and now Director. Dr. Sunny has become the head of one of the largest fleets of mobile dental clinics in the nation, second only to the U.S. military. With a legacy of over 50 years, UCS's mobile dental clinics are staffed by dental hygiene and dentistry students and provide comprehensive dental care to thousands of children in low-income and vulnerable populations across Central and Southern California. There is no question of how difficult it is to manage such a multifaceted organization, yet when asked about her appointment as Director, Dr. Sunny humbly responds by saying that "the mobile team of staff and faculty really know how to run it with or without a director so I am very lucky to be a part of this incredible team!"

Beyond her involvement in the Mobile Clinic, Dr. Sunny is also involved in other outreach programs such USC's Dental Humanitarian Outreach Program (DHOP). She ran DHOP for nearly 10 years, and though she recently stepped away from her role, she has been essential in the transformation of the program from a small group of students without faculty to an impressive team that has served thousands of patients across the world. During their most recent trip to the Philippines in 2019, members of the DHOP team were able to deliver partial removable dentures, quadrant dentistry, oral hygiene instructions, over 60 endodontic treatments, and over 400 cleanings within just five days.

Through USC's Mobile Clinic, DHOP, and other community outreach initiatives, Dr. Sunny serves as a mentor to

dental students, teaching them how to provide the best quality care for children in need. She pushes students to not only become skilled in dentistry, but have empathy, kindness, and love for their patients. Many of the children who are treated at the Mobile Clinic have been traumatized by previous poor experiences at the dentist and are faced with students who have little experience in behavior management. Without the assistance of sedation, students must learn how to build trusting relationships with their patients. "[We're] trying to get the best quality of care for a child that has no other option," Dr. Sunny states.

Outreach programs like Mobile Clinic not only change the lives of the patients who are treated, but also change the lives of the students who get the chance to volunteer. Over the years, Dr. Sunny has seen firsthand the huge influence that service trips, both domestic and international, can have on student experiences. She relates,"I definitely have seen the impact [DHOP and Mobile Clinic have] on students over and over again on the path that they choose.... I've seen many students go into community service and community health because of their experiences." The life-changing and unique experiences that community outreach provides make Dr. Sunny a strong proponent of dental outreach as an essential part of the dental school experience.

Dental outreach certainly does not come without its challenges. "Our biggest hurdle in community dentistry is that we're constantly getting money to fix things rather than prevent them," she says. Fortunately, recent years have seen public health and community dentistry move more towards preventative care rather than emergency care, with the onset of many programs for sealants, cleanings, and oral hygiene education. Educational disparity is one of the greatest challenges in community dentistry, as a large majority of patients have never been instructed in oral hygiene. This unfortunate fact highlights the importance of placing an emphasis on education during outreach programs, which can in turn help to empower communities and provide a lasting impact, long after the end of a particular community dentistry initiative.

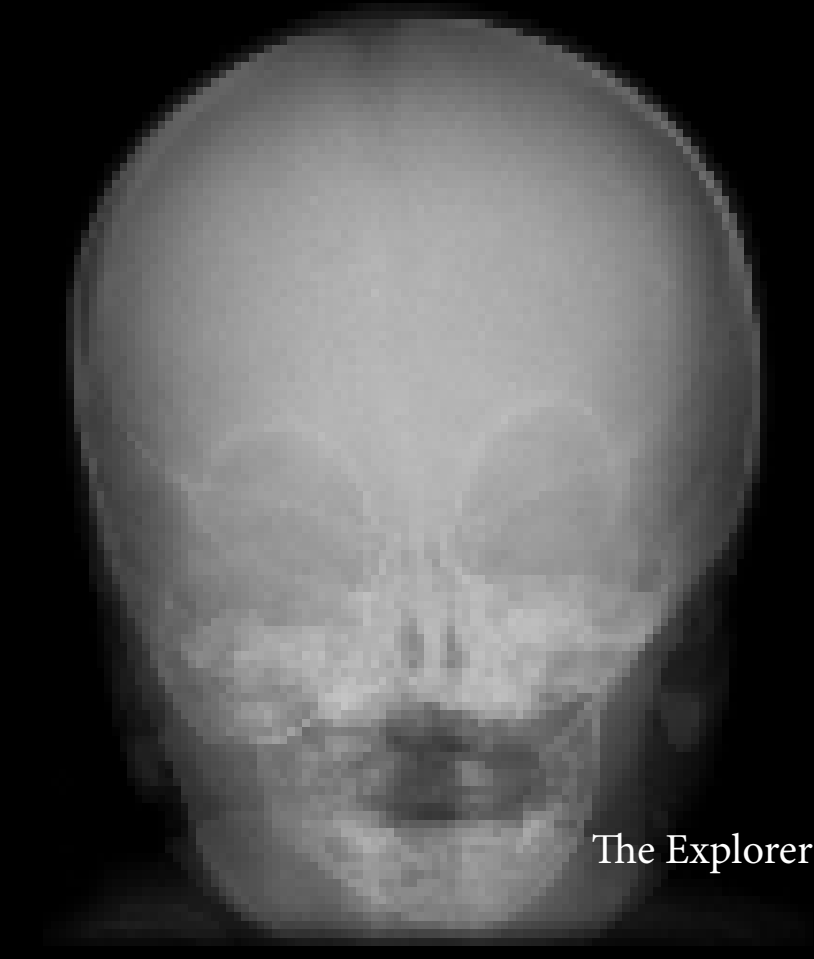
The story of Dr. Sunny's success is one which highlights how one modest person with an idea can soar to incredible heights with the appropriate mentorship, tutelage, and most importantly, belief. Through Mobile Clinic, DHOP, and lectures throughout the Ostrow School's DDS program, she aims to encourage students to remain motivated, passionate and inspired to want to change disparities in dentistry. Using one's knowledge and expertise to better the communities around them could perhaps be considered the essence of our dental profession, wouldn't you agree? In the spirit of service, and with the same encouraging words that Dr. Beale left with Dr. Sunny, we ask you: "how are you going to make the greatest impact?"

An Interdisciplinary Collaboration Gives New Hope for Craniosynostosis

Catherine Frusetta and Ilan Kaboud

Many great scientific discoveries and concepts could not have been developed without the uniquely complementary contributions of a diverse team. With larger and more varied teams, each member can contribute expertise in different fields, concepts, and ideas in order to achieve a more comprehensive view of the topic at hand.

The Department of Biomedical Sciences at USC perfectly exemplifies this concept of diversifying science. There, Dr. Yuan Yuan, Dr. Mengfei Yu, and Dr. Li Ma bring together their expertise in sequencing and molecular signaling, neuroscience and basic behavior, and biomaterial sciences, respectively, to contribute to tackling an interdisciplinary research topic with great potential for impact on patient health. Together, along with their principal investigators Dr. Jianfu-Chen and Dr. Yang Chai, and a multitude of other colleagues, they spearheaded an article published in January 2021 in the prestigious journal *Cell* titled "Cranial Suture Regeneration Mitigates Skull and Neurocognitive Defects in Craniosynostosis."



Dr. Yuan Yuan received his Ph.D. in Biomedical engineering at the University of South Florida. He then went on to join Dr. Chai's lab as a Postdoctoral Scholar - Research Associate in 2016 and is now a Senior Research Associate in the Chai lab. He brings to the team his engineering background, which allows him to look at the field of biology from a different perspective. His interest in research stems from his desire to explore how stem cells choose their fates and differentiate into different cell types. Dr. Yuan's contributions to the collaboration with Dr. Ma and Dr. Yu occurred through his ability to "connect the dots" concerning how a craniofacial defect on a molecular level can give rise to a cognitive defect with the help of Dr. Ma. Dr. Yuan also contributed specifically to the craniosynostosis project through analysis of cellular movement during suture regeneration, cellular sequencing, and also with the surgical elements of the project. Along with the paper that he published with the two aforementioned colleagues, Dr. Yuan also displays a vast inventory of past publications and research interests. He is especially proud of his contributions to neural crest cell migration research, where the Chai lab has challenged the previous understanding of neural crest cell differentiation and movement during first pharyngeal arch morphogenesis.

Dr. Mengfei Yu earned his Ph.D. in Stomatology at Zhejiang University and was a Postdoctoral Scholar – Research Associate in the Chai lab at the Center for Craniofacial Molecular Biology until his recent return to Zhejiang University as an Associate Professor. Dr. Yu is no stranger to research science, with many publications concerning stem cell tissue regeneration and material sciences and engineering. Dr. Yu has published more than thirty papers in international journals.

The craniosynostosis project aligned perfectly with Dr. Yu's interests in stem cell regeneration. Dr. Yu played a role in every step of the study. He did hands-on experi-

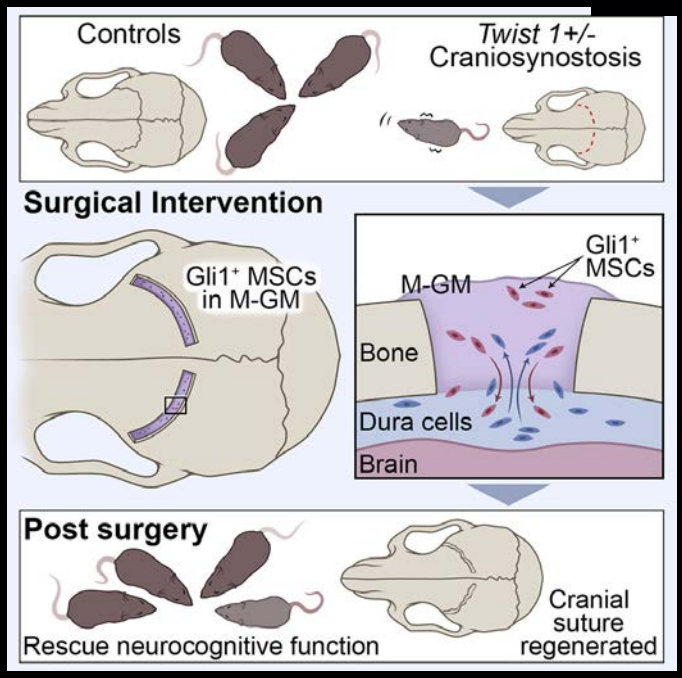
mental work, analysis, and assisted in writing the paper. He also greatly contributed to the development of the biomaterial which served as a scaffolding for suture regeneration. Dr. Yu is currently continuing his research in tissue regeneration for functional tissue organ systems, thus cultivating his knowledge and skill in stem cell research.

Dr. Li Ma has a Ph.D. in Genetics and joined Dr. Chen's lab, then at the University of Georgia, to begin his path into neuroscience in 2016. He followed Dr. Chen to the USC Center for Craniofacial Molecular Biology as a Postdoctoral Scholar – Research Associate in 2017. The transition from genetics to neuroscience was difficult for Dr. Ma, but through his research he has garnered a proficiency in molecular and cellular mechanisms of neurologic development and disease. Dr. Ma became interested in the project when Dr. Yu presented his progress in a seminar which Dr. Ma attended. After the seminar, Dr. Ma met with Dr. Yu to discuss the effect of craniosynostosis on brain size and subsequent neurologic deficiencies. This spurred a collaboration as Dr. Ma joined the project and offered his expertise in mouse neuroscience and cognitive testing, and he quantified the neurological effects of the mice during the course of the project. Outside of his work on the paper, Dr. Ma is also interested in looking at the cellular and molecular mechanisms of autism spectrum disorder as well as frontotemporal dementia.

The project that eventually became the 2021 *Cell* paper got its start when Dr. Yu outlined the major experiment design along with Dr. Chai. Later, Dr. Yu encouraged Drs. Yuan and Ma to collaborate, and the three were each able to contribute their distinct skills to the project.

This study gives new hope to patients with craniosynostosis, a birth defect in which the bones of an infant's skull fuse together prematurely at the fibrous joints known as the cranial sutures. The resulting skull deformity can have devastating effects including intellectual disability if not surgically corrected due to the pressure it puts on the developing brain. Currently, highly invasive surgery is the only treatment for those afflicted with this disorder, and patients often suffer suture re-fusion afterwards, necessitating a second operation. The team of USC scientists set out to examine whether suture regeneration could be an effective alternative treatment, based on the Chai lab's previous groundbreaking identification of stem cells that reside in the sutures, a study which was published in *Nature Cell Biology* in 2015.

In the process of investigating the possibility of suture regeneration, the team established the very first model of neurocognitive deficits associated with craniosynostosis, namely Twist1+/- mice with suture fusion. These specific mice model the neuroanatomical and cognitive dysfunctions seen in human craniosynostosis patients, giving the scientists an unprecedented view into the disease.



Working with these mice, Dr. Yuan played a part in surgically applying the biomaterial the team dubbed GM-Ma, which was developed by Dr. Yu and consists of an optimized combination of GelMA, Matrigel, and Collagen I. The GM-Ma acts as a scaffolding on which mesenchymal stem cells differentiate to produce a patent suture that acts like a natural one, restoring the skull's ability to grow in concert with the brain. Here, Dr. Yuan was also able to provide insight through his specialties in cellular differentiation and movement. An important finding was that regenerated sutures reversed the skull deformities in the mice and improved their neurocognitive functions, which were measured by Dr. Ma.

This study serves to establish key concepts about the molecular, cellular, and circuit mechanisms about neurocognitive dysfunctions in craniosynostosis mouse models. Additionally, the clinical implications of the research are clear and present the possibility that the technique could be translated to infants with craniosynostosis. This could greatly improve quality of life for those with craniosynostosis and would represent a significant improvement over the current surgical treatment.

This study was made all the richer by the combined specialties of Dr. Yuan Yuan, Dr. Li Ma, and Dr. Mengfei Yu. The three researchers have significant complementary expertise in their respective fields and are pleased with the results of their first project together. On the heels of this success, they express their interest in collaborating on projects together in the future.

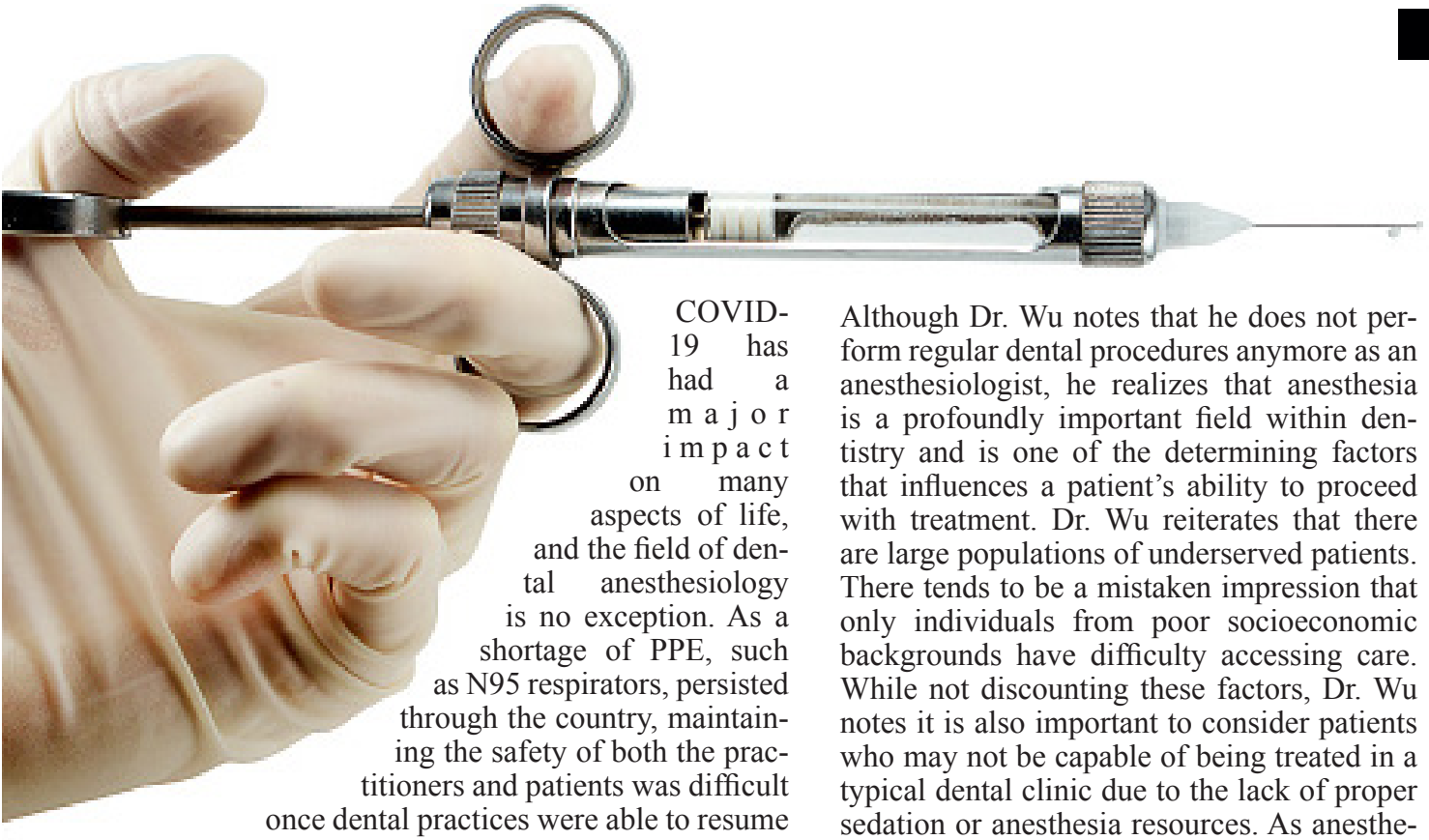
Compassionate Care through Dental Anesthesiology

Iris Yu and Danielle Min

Dental anesthesiology involves a dynamic daily schedule, assisting in a wide range of procedures while attending to patients of all ages and backgrounds. As a dental anesthesiologist, Dr. Yuen Ryan Wu provides anesthesia support on the first floor of the Herman Ostrow School of Dentistry to pediatric, special needs, and elderly patients. Dr. Wu attended UCLA for his undergraduate education before joining USC for dental school in 2004. After graduating, he remained at USC as a faculty member before pursuing his three-year residency in dental anesthesiology at SUNY Stony Brook University Hospital. Since his return to USC, Dr. Wu has chosen to focus on treating the pediatric and special patient populations and contributing his expertise to teaching and patient care.

Like many third-year dental students, Dr. Wu was introduced to a new world as he started his tenure as a student dentist. Dr. Wu has always carried a passion and curiosity for helping the special patient population as he was aware of the disparity of access to dental care for this large group of underserved community members. During one of his first rotations in the special patients clinic, he confirmed the many special needs that were prevalent within this population. These patients often present complex cases that require a meticulous treatment plan to ensure safe delivery of care. This compassion and eagerness to serve resulted in his application to the special patients selective program, which is still active today. The selective program primarily treats patients who are categorized by the American Society of Anesthesiologists as type 3 (patients having severe systemic disease) and are considered at higher risk, requiring the assistance of multiple departments.

During his time within the selective, Dr. Wu was invited to participate in a general anesthesia case in the OR. Upon entry, he met Dr. James Tom, the supervising dental anesthesiologist on the case and a current Associate Clinical Professor in the Anesthesiology Department at Ostrow. This encounter would mark his first exposure to dental anesthesiology and the beginning of his journey in this field. As his interest in dental anesthesia grew, he shadowed Dr. Tom and participated in airway checks and sedations, procedures quite distinct from those performed by other specialties, as the only dental student. During this time, Dr. Wu noted a huge population that did not have access to dental care because dental clinics were unwilling or just did not have the resources to see the special patient population. It was profound to see how the ability to administer anesthesia allowed for many of these patients to finally receive care.



COVID-19 has had a major impact on many aspects of life, and the field of dental anesthesiology is no exception. As a shortage of PPE, such as N95 respirators, persisted through the country, maintaining the safety of both the practitioners and patients was difficult once dental practices were able to resume operations in May 2020. As the need for surgeries and sedation did not halt because of the pandemic, obtaining the required supplies was necessary to continue providing this vital dental care. Through lowering the number of scheduled surgeries and with the aid of the ADA and CDC, Dr. Wu was able to obtain sufficient PPE to continue patient care. Dr. Wu noted that once patient care had safely resumed, he saw a large population of pediatric patients, which may be attributed to a lack of proper oral hygiene at home leading to increased development of caries.

Today, Dr. Wu can be seen at USC teaching students and utilizing his skills to reduce anxiety and provide comfort during dental procedures through general anesthesia. On Wednesdays, Dr. Wu treats pediatric patients, and on Thursdays, he attends to special needs patients. When he is not at the dental school, Dr. Wu can be found at his private practice group treating a more diverse group of patients. Dr. Wu describes dental anesthesiologists as "lone rangers" who often work independently even when they are in a group practice setting, one of the unique aspects of the job.

Although Dr. Wu notes that he does not perform regular dental procedures anymore as an anesthesiologist, he realizes that anesthesia is a profoundly important field within dentistry and is one of the determining factors that influences a patient's ability to proceed with treatment. Dr. Wu reiterates that there are large populations of underserved patients. There tends to be a mistaken impression that only individuals from poor socioeconomic backgrounds have difficulty accessing care. While not discounting these factors, Dr. Wu notes it is also important to consider patients who may not be capable of being treated in a typical dental clinic due to the lack of proper sedation or anesthesia resources. As anesthesia becomes further integrated into dentistry, this field can now include a population that has not historically had equal access to care. Dr. Wu encourages anyone who is interested in working with the special patient population to come to the first floor to experience the impact and importance of general anesthesia in dentistry.

A Day in the Life of an Attending in a General Practice Residency

Abigail Helena & Brandon Pham

As an attending at both the LAC+USC Medical Center and UCLA Medical Center with 30 years of experience as well as the owner of a private practice, Dr. Kari Sakurai is a passionate individual who aims to provide only the best outcomes for her patients, mainly specializing in cosmetic and general dentistry. Dr. Sakurai's path to dentistry was inspired by a bike accident in high school where she would have lost both of her two front teeth if it weren't for the skillful work of her dentist. Although traumatic, this experience put her on a mission towards becoming a dentist.

After graduating from the University of California - Irvine with a degree in biology, Dr. Sakurai received her DDS degree in 1989 from UCLA before beginning a general practice residency in hospital dentistry at UCLA Medical Center, where she was exposed to a variety of medical cases and professions. Hospital dentistry is "extreme dentistry," according to Dr. Sakurai, and one of the main reasons why she pursued a general practice residency at UCLA. Working as the first dentist on the heart & lung transplant team, Dr. Sakurai helped to provide patients with a basic dental clearance, which is especially important for immunocompromised patients, as lives can be at risk due to seemingly trivial bacterial infections within the oral cavity. Dr. Sakurai also worked closely with doctors of other departments, which she believes leads to better outcomes for the patients. Dr. Sakurai's current role as an attending for the USC General Practice Residency (GPR) comes with great responsibility and prestige. She often sees trauma cases that a private practice dentist may not ever come across. For instance, Dr. Sakurai recently performed oral surgery on the victim of a surfboard accident, as the physical trauma had resulted in roots becoming exposed. Also, as part of the selection committee, Dr. Sakurai helps to inform other medical specialists that dentistry is a systemic issue that must be carefully observed and treated, enabling the specialists to become better educated in identifying specific oral conditions in their patients. Working in such clinically and mentally challenging roles, Dr. Sakurai developed skills in performing CPR, treating the medically compromised, performing sedation, and responding to a variety of ever-changing medical emergencies.

As an attending at both the UCLA Medical Center and the LAC+USC Medical Center, not only does Dr. Sakurai

treat patients, but she also supervises the residents during rotations. The cases seen by Dr. Sakurai and the residents at USC are unique and unlike anything one would see outside of a hospital setting. For example, a resident encountered a patient with ameloblastoma that needed resection and further treatment with an implant-retained obturator; in such a case, a distinct set of skills must be mastered in order to improve the patient's quality of life. The residents at USC are in a constantly changing environment, and must run cases by Dr. Sakurai every day to ensure that proper treatments are being administered. Residents may also perform consultations in other units, including the ICU and cardiac departments.

Dr. Sakurai also runs the Pacific View Smile Center in Santa Monica, CA, where she operates similarly to the services that she provides as an attending. A wide range of more traditional dental services are also provided, including periodontics, Invisalign®, and other cosmetic dental procedures. Even outside of her usual working schedule, she is dedicated to serving her community, being the former president of the Academy for Excellence in Dentistry and working with the American Heart Association, the Give Back a Smile program, and cancer research organizations.

During 2020, both the LAC+USC Medical Center and Dr. Sakurai's private practice were forced to adapt to the ever-changing restrictions and regulations enforced by the state of California in order to provide patient care while minimizing the risk of transmission of SARS-CoV-2. The GPR program especially was put under a lot of stress, as it had to accommodate patients from the dental school and community, as well as emergency patients. LAC+USC is the number one trauma center in Los Angeles, so the residents and doctors had to come together to work and treat patients to get them out of trouble. Extreme measures were put in place, which involved obtaining the necessary personal protective equipment, purchasing HEPA scrubbers, and rearranging the entire layout of the hospital. Currently, before any patient is admitted, a thorough screening and testing procedure is completed beforehand as a precaution to keep patients as safe as possible. The LAC+USC Medical Center mainly serves a large portion of the prison population, most patients were largely unaffected even after the onset of the pandemic, but many precautions were put into place to ensure that both patients and medical providers would be protected from the virus.

To any dental students who are considering applying to a hospital-based GPR program, Dr. Sakurai strongly recommends submitting an application. Although only approximately four residents are chosen per application cycle out of about 70-80 applicants, the GPR program offers unparalleled hospital-based experience, according to Dr. Sakurai. Residents find themselves constantly learning and performing new procedures, working in the emergency room and taking extra calls, and making new connections with various other medical workers. As noted by Dr. Sakurai, the vigorous one-year program at USC will place you on equal footing with those who have been practicing for two or three years. In addition, a vast array of financial aid options are offered to residents, including student loan deferment, stipends, medical insurance plans, and retirement plans, which can make it easier for students who may be worried about financial burdens to focus more on furthering their education. As an added bonus, students who complete their residency also receive the equivalent of about 150 continuing education (CE) units, which can translate to approximately two years before having to take more CE courses. Both the USC and UCLA GPR programs are heavily centered around hospital dentistry, last around 12 months, and involve rotating through a variety of dental experiences, including oral surgery, anesthesia, and emergency medicine. In USC's GPR program, residents train under faculty members from both the Keck School of Medicine and Herman Ostrow School of Dentistry, and training is completed at the LAC+USC Medical Center and Veteran's Affairs Outpatient Clinic. Because there are only four residents, the relationships that residents form with the faculty and doctors in other fields are often tight-knit. This gives residents a boost in finding jobs after graduation because of the network of connections one can establish at USC. Not only will you receive much hands-on experience, but the mentorship you will receive in the GPR will be an invaluable investment in a long, fulfilling career in dentistry.

As a tip, to help ensure that one's application will stand out when applying to a GPR, Dr. Sakurai recommends shadowing a physician in a GPR program, which would be useful to grasp a better understanding of hospital dentistry and the procedures that are carried out, as well as to demonstrate to the faculty that the applicant shows a strong interest in the field. Students who have the ability to communicate and interact effectively with other physicians, as well as students who perform research that may be pertinent to hospital dentistry, will also likely be given more careful consideration during the selection process, as they tend to possess the skills needed by residents to make logical fact-based decisions and to communicate ideas efficiently between both patients and doctors.

When asked about whether a hospital-based GPR is better than a non-hospital based GPR, Dr. Sakurai's response was, "Absolutely, you will not get that experience anywhere or information else in the world. It's just about earning a little respect because you can [handle trauma] and you're not afraid to handle something like that. When you see the big stuff, you can appreciate it, and you can appreciate how people think and how physicians/colleagues think, and how you can be a part of that healthcare team. I think that's key, and I'm having fun doing it."

Committing to the Advancement of **Orthodontic Education** and **Research**

Scott Barlow and Yoo Jin Kim

Dr. Hovhanness Ivan Shnorhokian was born and raised in Beirut, Lebanon. He attended the American University of Beirut, where he received his Bachelor's Degree in Biology. While Dr. Shnorhokian had always had an interest in dentistry, the only dental school in Lebanon was on a French system. He set his mind to learning the French language and spent a summer working in France in order to immerse himself in the language. Ultimately, Dr. Shnorhokian followed his dreams and overcame personal, professional, and language barriers to receive his D.D.S. from Faculte Francaise de Medicine Et Ecole Dentaire, in Beirut, Lebanon. When reflecting on this experience, Dr. Shnorhokian remarked that "with motivation and drive, you are able to achieve anything you strive for."

Following completion of dental school in Lebanon, Dr. Shnorhokian entered work in private practice as a general practitioner. His interest in craniofacial growth and development motivated him to pursue specialty training in orthodontics, and he moved to the United States after being accepted to the orthodontic program at the University of Pittsburgh where he received his Master of Dental Science in Dentistry and Certificate in Orthodontics. Dr. Shnorhokian continued his post-doctoral studies at the University of Pittsburgh and earned his Ph.D. in Higher Education in 1990. While in his orthodontic residency program, Dr. Shnorhokian had the first of his three children. His oldest daughter, currently working as a lawyer living in San Diego, has blessed him with two grandchildren. His second daughter works as a therapist in a hospital in Long Beach, and his third is a biomedical engineer working in Santa Monica.

After serving as the Acting Chairman of the University of Pittsburgh Department of Orthodontics, Dr. Shnorhokian moved to Los Angeles to join the USC Orthodontics Department as Clinical Associate Faculty. Dr. Shnorhokian also serves as the Co-Director of the Undergraduate Orthodontics course and thoroughly enjoys spending time with his students. As part of a continuous journey to construct an intellectually rewarding curriculum, his current goal is to allow DDS Class of 2024 students to use iTero scanners to analyze their own occlusion in preparation for the 2nd year Orthodontics course. Dr. Shnorhokian hopes that this exercise will allow students to better understand evolving diagnostic technologies and help new clinicians to determine which of their future patients may benefit from referral to an orthodontist. After students complete the pre-clinical Orthodontics module, Dr. Shnorhokian hopes that they feel confident in properly identifying orthodontic needs.

During his career at the University of Pittsburgh Department of Orthodontics, Dr. Shnorhokian was involved in various research projects. His earlier studies focused on the effects of sickle-cell disease on skeletal maturation of the dentofacial complex in American black children. The cephalometric results showed that patients with sickle-cell disease exhibit significantly retruded maxillary and mandibular incisors as well as a tendency to have a more protrusive maxilla and a more forward growth of the mandible. His work has since been cited by recent studies that focus on managing orthodontic treatment with sickle cell disease.

The following year, his research regarding the influence of perennial allergic rhinitis with an allergic component (PRAC) on facial type was published. While working towards his Master of Dental Science degree and lat-

er as an Assistant Professor, Dr. Shnorhokian and his co-investigator received a research grant from the NIH for this project. In this study, Dr. Shnorhokian studied a group of children aged 5-10 years with PRAC to determine if allergy management is able to alter the facial growth pattern. His research showed that his group of patients showed a significantly greater palatomandibular angle and lower anterior facial height compared to the matched control sample. Additionally, transverse cephalometric measurements of the PRAC patient showed significantly narrower bilateral orbital breadth, bizygomatic, and binasal dimensions than the control sample. Although his study indicated that PRAC with chronic mouth breathing can affect midface development, his pilot study of PRAC patients who received 2 ½ years of allergy management showed no significant dento-facial dimensional change, and thus, the effect of allergy therapy on altering facial growth pattern is still uncertain.

Another research study conducted by Dr. Shnorhokian compared the dentofacial morphology of 35 bruxers to 28 non-bruxers. Anthropometric spreading calipers were used to measure direct head and facial size from which cephalic (head width vs. head length), facial (face height vs. face width), and "gonial" (gonial width vs. zygomatic width) indices were calculated to determine the headform and facial type for all subjects. Results showed no difference in the dentofacial morphology between the two study groups, but a predominant craniofacial type and dental morphology of both study groups were identified, which included dolichocephalic headform, euryprosopic facial type, and Angle Class I dental occlusion.

Dr. Shnorhokian continued to delve into dentofacial morphology patterns by retrospectively analyzing the effectiveness of Class II, division 1 treatment in terms of two outcome variables. These variables included the percentage change in a valid and reliable occlusal index, the Peer Assessment Rating (PAR) score, and the duration of treatment were calculated from a population of 250 subjects with Class II, Division 1 malocclusion who were treated in the Orthodontic Department of the University of Pittsburgh over the span of 12 years. Multiple regression techniques were used to evaluate the relationship between the outcome and the treatment variables. While the pretreatment PAR score was the only variable that influenced the percentage change in PAR, there were five treatment variables that were significantly associated with the duration of treatment, which included (1) the pretreatment PAR score, (2) the number of treatment stages, (3) the percentage of appointments attended, (4) the number of appliance repairs, and (5) whether the patient was treated with or without extractions.

Outside of school, Dr. Shnorhokian immerses himself in serving his community. He regularly volunteers for the Armenian Evangelical Church and works for the Armenian Benevolence Organization, which oversees churches all over the world. Amidst the pandemic, Dr. Shnorhokian has continued to actively contribute to the Ostrow community, maintain involvement with his church, and find ways to connect with his family. Dr. Shnorhokian is an integral member of the USC Orthodontics Department, and his contributions to the field continue to inspire his students and colleagues.

Locomotor Learning & Rehabilitation

Andrea Diaz

Dr. James Finley is an Associate Professor in the Division of Biokinesiology and Physical Therapy, and the Director of the Locomotor Control Laboratory at USC. His academic journey began as an undergraduate student at Florida A&M University, where he studied Mechanical Engineering due to his interest in automotive engineering and control systems. During his undergraduate years, Dr. Finley had the opportunity to intern at a medical device company in Minnesota, working in their Cardiac Surgery Technologies Division. His exposure to the medical field shifted his career goals and encouraged him to consider ways to combine both engineering and health. Dr. Finley began to pursue his passion in biomedical engineering and states that one of the things that excited him the most about the field is, "…how the brain and nervous system, interacts with our muscular skeletal system to produce movement." He wanted to understand how it all worked and apply engineering principles to that process since there are lots of parallels between biological systems. The ultimate goal for him was to use that knowledge to improve rehabilitation.

During his doctoral degree in Biomedical Engineering from Northwestern University, Dr. Finley learned how to read literature, ask scientific questions, and think critically about the advantages and limitations of different approaches to answer the questions he had about his field. It was there where he began to learn more about how to communicate science both in a professional setting, and to a broader audience in a way that people could understand.

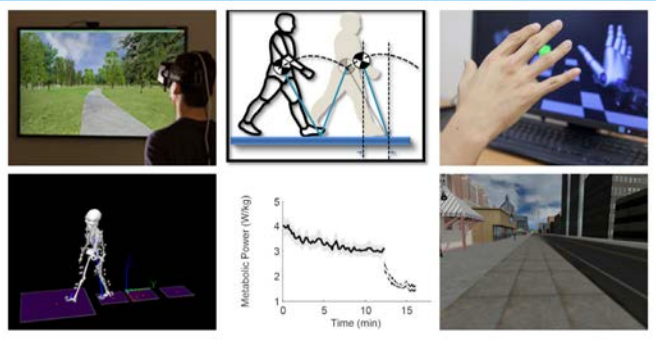
As a postdoctoral student in Neuroscience at Johns Hopkins University, Dr. Finley had the opportunity to work with other passionate individuals within his field who helped him gain experience in running a laboratory and learn ways to build community within that space in order to excite students about their projects. During his time at Johns Hopkins, Dr. Finley knew that he wanted to become a faculty member and start his own laboratory.

In August of 2013, Dr. Finley joined USC and his first major accomplishment was building his Locomotor Control Laboratory in 2015. At the time of completion of his laboratory, Dr. Finley had a list of projects that he wanted to begin. He recruited students and began executing projects that were assigned to him, while also working on new projects that were developing through conversations and collaborations with other passionate researchers at USC.

Dr. Finley and his Locomotor Control Laboratory examine the ways in which movement is controlled and adapted in both the healthy and injured neuromuscular system. A lot of the work conducted in the lab focuses on the development of theoretical models and experiments based on principles of neuroscience, biomechanics, and exercise physiology. The goal of his work is to assist populations with damage to the nervous system by designing novel and effective interventions to improve their mobility.

Dr. Finley's favorite part of research is meeting with his students, discussing new ideas for future projects, and working on the process of designing and experimenting a new project. Meeting with his students

to discuss and analyze data is the part that excites him the most because it is the core of their research; making measurements about how people move, what they do, and what their decisions are. They take this data to infer new knowledge that they were unaware of before, which is then used in the development of their research.



A new project sponsored by the National Science Foundation is in the works for Dr. Finley and his laboratory. They will study the ways in which people *trade-off* risk and effort during walking by examining the decision-making process of individuals when they are faced with a situation that requires them to move their body somewhere safely. For instance, imagine that you are on a hike and need to cross a stream to continue onto the trail. There are two paths that you can take, one of them is short but the rocks are slippery, and you would risk slipping and falling but you could get to the trail quickly. Your second option is a path where the water is shallow and wider, but it will require more time and effort to cross. Hypothetically, which path would you take to cross the stream safely? This is the concept that Dr. Finley is fascinated with because these are the types of decisions we consider when making movements with our body. This idea also comes up in the context of pathology, especially when observing the movement of individuals who have had a stroke and have lost some form of mobility in their body. They may choose to walk with a more effortful strategy that may not look optimal to an able-bodied individual, however, it may be optimal for them given that they are willing to spend more effort to minimize the chances of them falling.

This project is one example of a much broader set of work in the world of what Dr. Finley and his lab call *motor control* and *motor learning*, in order to understand why people move the way they do. The project also applies principles from a field referred to as *behavioral economics*. This approach will allow them to design new experiments and integrate their virtual reality related work that focuses on the ways people respond to trips and slips when walking.

When asked what advice he would give to students who are thinking about getting involved in research, Dr. Finley suggests that students to commit a year at a laboratory in order to obtain a meaningful experience. A year of work at a laboratory is sufficient for a student to learn new skills and make an original and independent contribution to research. That time will also be beneficial in understanding how the research process works, given that the experiences in a laboratory are unlike the experiences one will have in their educational courses.

Dr. Finley encourages undergraduate and graduate students who are involved in research to think about their work and how it can translate into a publication. He encourages students to talk to their advisors in order to receive guidance in relation to their own goals and long-term career. Dr. Finley states, “If you want to do research over the long run, I personally think that research should be something that excites you.” Dr. Finley considers research a challenging career, but in order to get over those challenges and stay motivated, one needs to be passionate about the questions that they are asking. Although it may seem at times that undergraduate and graduate students have limitations as to what they can do, he encourages them to keep moving towards the direction of doing work that inspires them and motivates them to do all the things necessary to conduct their experiments, debug, start over, and move forward.

Improving the Neurodevelopmental Outcomes of Preterm Infants in the NICU through Positive Sensory Exposures

Chenxin (Cindy) Li

Dr. Bobbi Pineda is one of the newest faculty members in the USC Chan Division of Occupational Science and Occupational Therapy, having joined the department in February 2020. Dr. Pineda received her Bachelor of Health Science (BHS) in Occupational Therapy in 1992 from the Florida Agricultural and Mechanical University. She always wanted to become a pediatric clinician. Thus, she started working in pediatrics right away after graduating with her Bachelor's degree, but quickly realized that she had a lot more to learn. So, Dr. Pineda went back to school to get her Master of Health Science (MHS) degree in Occupational Therapy at the University of Florida one year later in 1994. After completing her Master's degree, she practiced for several years and worked in many different settings that included the neonatal intensive care unit (NICU). She especially enjoyed working in the NICU, because it was so specialized. However, in the 1990s, there was much less understanding about the role of the occupational therapist. Luckily, occupational therapy in the NICU has boomed, and occupational therapists consist of the largest proportion of the 3 disciplines who make up the multidisciplinary rehabilitation team in the NICU. Dr. Pineda's career path was further cemented when she gave birth to her first child, who was born 2.5 months early and spent his first 5 weeks of life in the NICU. This was a pivotal point in Dr. Pineda's life, as she now had the personal experience of being a NICU parent coupled with her professional interest in working with high-risk infants. She wanted to be able to give back to premature infants through research, so she decided to go back to school again to pursue her PhD. In 2006, she received her PhD in Rehabilitation Science from the University of Florida.

Dr. Pineda's research is aimed at better understanding the early factors that can help to improve neurodevelopmental outcomes, specifically in "preemies." Her research focuses on the time right after the preemie is born, when they are still in the NICU, and follows these babies through childhood. While there are some factors that cannot be avoided, such as the need for stressful medical interventions, there are many factors that are modifiable within the NICU environment and can make a difference in improving outcomes. Modifiable factors she investigates include therapeutic interventions performed on the preemies within the medical environment, strategies to decrease the impact of stressful exposures, and the impact of sensory experiences (amount of light exposure, amount of time parents hold the child, whether the parents are engaged in care, etc.) on brain development and outcome. One of the more surprising results that came from her work was when she studied the impact of the NICU environment on high-risk infants. Many hospitals have an "open ward" style NICU, where the beds are stacked very close together in one large room. Nowadays, hospitals are moving towards a more private environment with single patient rooms consisting of three solid walls and a fourth glass wall. This design allows nurses to be able to check in on the babies easily and for parents to have a private space to spend time with their baby. Dr. Pineda looked at how the private rooms could reduce stress since the babies in this type of environment are not exposed to as much activity, noise, or light during a period of immaturity, where their sensory systems may not be able to tolerate it. Surprisingly, the results showed that babies in the private NICU setting actually did worse – these children had significantly poorer language outcomes at 2 years of age and already had brain structural differences at the time they left the NICU. For context, this study was conducted in an area with many families of low socioeconomic status. With that comes challenges which make it harder for these parents to

come into the NICU and engage with their babies. Thus, the babies often were in a quiet and dark private rooms devoid of age-appropriate sensory exposures. Therefore, in hindsight, the results of the study made sense, and highlighted the need to better understand and ensure positive sensory experiences within the NICU environment.

Bridging this and other work she has done, Dr. Pineda devised the Supporting and Enhancing NICU Sensory Experiences (SENSE) program, a sensory-based intervention that aims to engage parents in providing age-appropriate, positive sensory exposures (auditory, tactile, vestibular, kinesthetic, visual, olfactory) to their infants in the NICU. This program defines the appropriate doses for each sensory exposure for each day of NICU hospitalization, something that has never been clearly specified before. To develop this program, Dr. Pineda and her team first performed a literature review of all the scholarly articles from the past 20 years on sensory exposures that were associated with positive neurodevelopmental outcomes. Then, they pulled together all the evidence to define what activities to do in each domain of sensation and defined the age at the time of beneficial sensory interventions. Next, she sought expert opinion to fill in the gaps from the evidence to gain a better understanding of the different sensory interventions one should do across time. During this process, she also engaged parents of NICU infants. It was very important to Dr. Pineda to make the program parent-friendly, because there is mounting evidence that shows the importance of parents participating, with parents being the center of care in the NICU. The program provides a step-by-step guide in parent-friendly language describing what parents should do with their baby every day of NICU hospitalization, based on the baby's postmenstrual age, which is defined as the number of completed weeks of gestation at birth plus the number of weeks elapsed since birth. The SENSE program has been well received, with almost 250 hospitals in the US and abroad now incorporating it into their NICUs.

Recently, Dr. Pineda had several papers published on the SENSE program. One article, published in PLOS One, demonstrates the feasibility of the SENSE program and parents acceptance of it. Dr. Pineda recalled, "Before this program, even if parents came into the NICU to visit their babies, they would often feel disempowered, because they would not know what to do with their babies. Often, they would end up being on their phones sitting next to the baby's bedside. The SENSE program helps parents understand how important they are to their baby and serves to actively engage parents in establishing a relationship with their baby early on while providing appropriate sensory exposures to the baby. "In many ways, just knowing what you need to do and what can be done can be very empowering," Dr. Pineda explained. The article describes how early education on the SENSE program relates to more parent engagement in the NICU and that parents were able to complete a large number of sensory exposures defined in he SENSE program. The other article, published in Early Human Development, defined that more maternal confidence and better infant neurobehavior was observed among babies and families who used the SENSE program. One additional article, that is now in press, will define the impact of the SENSE program on later language development.

At USC, Dr. Pineda will continue conducting research with the hope that she can make an impact, improve the quality of life during the NICU stay, and improve neurodevelopmental outcomes. She looks forward to building a team of students and experts in other fields with varying expertise in order to further study the SENSE program in both the Children's Hospital LA (CHLA) and LAC+USC Medical Center. Dr. Pineda also is studying how the SENSE program gets implemented at different hospitals, what hospital characteristics allow the SENSE program to be more successful, and what adaptations may enable the SENSE program to be successfully implemented across different NICU settings. The program has been translated to Spanish, isiZulu, and Tswana, and translations are underway in Hindi and Hebrew. Dr. Pineda is excited about expanding the program to other languages and cultures to increase accessibility of the SENSE program among diverse families here in the United States as well as abroad. We welcome one of our newest faculty members and wish her great success as a Trojan!

RESEARCH DAY

MAY 26, 2021

SCHEDULE OF EVENTS

12:30 pm – 12:45 pm **Opening Remarks:**

Maja Matarić, PhD	Interim Vice President of Research
Avishai Sadan, DMD, MBA	Dean
Yang Chai , DDS, PhD	Associate Dean of Research

12:45 pm – 01:15 pm **Keynote Speaker: Steve A. Kay, PhD, DSc**
University and Provost Professor of Neurology, Biomedical Engineering and Biological Sciences
Director of Convergent Bioscience
Director, MESH Academy
University of Southern California

01:15 pm – 01:20 pm **Activity**

01:20 pm – 01:40 pm **Keynote Speaker: Mariela Padilla, DDS, MEd**
Associate Professor of Clinical Dentistry
Assistant Director of Distance Education Programs
Division of Periodontology, Dental Hygiene and Diagnostic Sciences
University of Southern California

01:40 pm – 01:45 pm **Activity**

01:45 pm – 02:05 pm **Keynote Speaker: James Finley, PhD**
Associate Professor of Biokinesiology
Associate Professor of Biomedical Engineering
University of Southern California

02:10 pm – 02:50 pm **Poster Presentation: Dentistry - Basic Sciences**

02:50 pm – 03:10 pm **Poster Presentation: Dentistry - Clinical Sciences**

03:10 pm – 03:40 pm **Poster Presentation: Occupational Science & Occupational Therapy**

03:40 pm – 04:10 pm **Poster Presentation: Biokinesiology & Physical Therapy**

04:10 pm – 04:15 pm **Break**

04:15 pm – 04:45 pm **Award Presentations**

KEYNOTE SPEAKERS

Steve Kay, PhD, DSc

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, DDS, MEd

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, PhD

Dr. James Finley is an Associate 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.

RESEARCH DAY POSTER ABSTRACTS

ADVANCED SPECIALTY PROGRAM RESIDENTS

Poster #1

Title: Temporomandibular joint findings in CBCT images

Authors: Kevin S. Berry, Mariela Padilla, Somsak Mitrirattanakul, & Reyes Enciso

Faculty advisors: Mariela Padilla, Somsak Mitrirattanakul, & Reyes Enciso

Background: The radiological evaluation of the TMJ includes a wide variety of images, including CBCT. The correlation of severity of TMD and radiological findings is unclear, with cases with degenerative disease showing an intact jaw function. **Purpose**: Evaluate radiological findings (CBCT) in the TMJ, and compare those findings with clinical diagnosis in patients with TMD. **Methods**: Retrospective study with 100 images (200 joints) from ≥20 years old patients. All cases were seen by the same provider from 2018 to 2020. Two independent clinicians analyzed the images to evaluate sclerosis, erosion, subchondral cysts, osteophytes, and flattening, following the protocol described by Arayapisit et al. (2020), and a radiological score was obtained by combining the indicated variables except flattening (physiological adaptation) (IRB# UP-20-00436). **Results**: 78% of the joints belonged to female patients. The main complaints were pain and headache (54%), reduced range of motion (21%) and joint noises (18%). The most common primary diagnoses were disc dislocation with reduction (36.5%), myofascial pain (20.5%) and osteoarthritis (15%). 96.5% of the joints showed degeneration, and the average radiological score was 3.86±1.46. Non-parametric tests showed that females had significantly higher score (p=0.011). There was a statistically significant difference in radiological score between muscle and joint (p=0.014), and in the score across 8 categories of diagnosis (p<0.001). There was no associaton between scores and chief complaint (p>0.05), or diagnoses associated with pain (p>0.05). **Conclusion**: There were differences among the radiological findings between genders and joint/muscle TMD, as well as across diagnoses as expected.

Poster #2

Title: Algorithms for creating a pre-encounter questionnaire for Orofacial Pain Clinic

Authors: Anette Vistoso Monreal & Glenn Clark

Faculty advisor: Glenn Clark

Background: According to the National Institute of Dental and Craniofacial Research (NIDCR), 12% of the population is affected by orofacial pain (OFP) conditions. These conditions present irregular clinical symptoms, making them challenging for care providers to diagnose and treat. The literature suggests that well designed diagnostic system could provide more structure through the data collection process that will determine a more accurate diagnosis. **Purpose**: The rationale behind our study was to create a pre-encounter questionary system based on data collection that is highly structured and therefore amendable to advanced data analysis (i.e. machine learning). Step one of this process involved finding a set of diagnosis-specific high-frequency variables which were extracted after text mining from 450 first visit narrative notes. All these patients attended a University-based Orofacial Pain Clinic. **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. Identified a set of diagnosis-specific HFVs defined as being present >/= 67% of the time. Of these original 137 variables, only 53 were found as HFVs associated with our diagnoses. Next, 25 diagnostic predictive algorithms were created to score individual patient data for each diagnosis. **Results**: The accuracy of the algorithms was examined using a new test data set of 50 additional first-visit narrative notes from Orofacial Pain patients. An acceptable accuracy score 0.87 (percent of time our predicted diagnoses and our actual diagnoses agreed). The algorithms were used to develop the smart questionnaire for patients. **Conclusion**: The predictive diagnostic algorithms used in this study demonstrated an acceptable initial accuracy hit ratio for our customized pre-encounter questionnaire.

Poster #3

Title: Antioxidants for oral mucositis in head and neck cancer patients

Authors: Nelli Karimyan, Afsheen Raza, Chitra P. Emperumal, Kamal Al-Eryani, & Reyes Enciso

Faculty advisors: Reyes Enciso & Kamal Al-Eryani

Background: Head and neck cancer (HNC) adult patients undergoing radiotherapy often experience oral mucositis, which is treated by various drugs, including natural/synthetic, oral, or topical antioxidants. This review focuses on the use of natural antioxidants in the management of oral mucositis. **Purpose**: To compare antioxidants' effectiveness in managing oral mucositis in HNC adults undergoing radiotherapy with or without chemotherapy with placebo. **Methods**: The Cochrane Library, MEDLINE, Web of Science, and EMBASE were searched for randomized controlled trials (RCTs) comparing antioxidants with placebo in HNC adult patients undergoing radiotherapy to assess the prevalence and severity of oral mucositis. **Results**: The initial search up to February 19, 2021, yielded 203 unduplicated references. A meta-analysis of 15 RCTs, including 718 adult patients, showed a significant improvement in mucositis severity score for all antioxidants except melatonin. Patients receiving vitamin E had 60% fewer chances to develop mucositis RTOG (Radiation Toxicity Grading System) grade 2 than placebo (P=0.040). No statistically significant differences were found in the incidence of severe mucositis and the number of patients requiring analgesics for melatonin, propolis/honey, aloe vera, and vitamin E compared to placebo in one trial. Due to unclear/high risk of bias, a small number of studies (2 for propolis/honey and zinc and one for curcumin, silymarin, and vitamin E) and sample size (<400 in each), the quality of evidence was low. **Conclusion**: Antioxidants provided a significant improvement in mucositis severity scores in these patients, but additional studies are needed

to confirm these results.

Poster #4

Title: Artificial intelligence for rapid clinical diagnosis in oral medicine

Authors: Jouliana Davoudi, Michael Asadoorian, & Parish Sedghizadeh

Faculty advisor: Parish Sedghizadeh

Medical errors are now the third leading cause of death in the US, accounting for 10% of all US deaths. Based on the American Cancer Society, estimated new cases in 2021 is about 54,010 and the mortality rate is about 10,850. The survival rate for this type of cancer is not high despite advances in surgery, radiation, and chemotherapy. Early diagnosis of oral cancer increases the chance of survival and improves the life expectancy of patients. The goal of Oromed AI is to improve clinical diagnosis by providing a simple AI tool to increase efficiency and accuracy in clinical diagnostics, while reducing errors. As proof of concept, our dataset is composed of 1089 high and medium resolution oral lesion pictures, consisting of 558 labeled as mucocele and 531 as lichen planus. These images are taken by clinical experts in oral medicine and pathology with training in intraoral photography. We used a classification scheme for oral lesion image classification based on deep convolutional neural networks (CNN). Convolutional networks are considered the state of the art technique for classification problems when the input is high-dimensional data such as images. These networks "learn" to extract local features from images and classify the input according to the extracted features. We trained the model on 70% of our dataset, 10% for cross-validation, and the remaining 20% for testing. Our testing model achieved an accuracy of 84.9% in lichen planus recognition and 76.02% for mucocele. AI can be an effective tool for rapid clinical diagnosis of oral lesions.

Poster #5

Title: Cannabis-based medicines for the treatment of chronic neuropathic pain

Authors: Bradley Sainsbury, Jared Bloxham, Masoumeh Hassan Pour, Reyes Enciso, & Mariela Padilla

Faculty advisors: Reyes Enciso & Mariela Padilla

Background: Chronic neuropathic pain (NP) is challenging to manage with current therapies, raising interest in the use of alternatives approaches such as cannabis-based formulations. **Purpose**: Evaluating the effectiveness of cannabis-based medicines in patients with chronic NP. **Methods**: Randomized placebo-controlled trials using cannabis-based interventions to treat adults with NP were included. Cochrane Library, MEDLINE, Web of Science and EMBASE libraries were searched up to February 1, 2021. Primary outcome was NP intensity. Risk of bias was analyzed based on Cochrane's handbook. **Results**: The search of databases up to 2/1/2021 yielded 379 records with seventeen RCTs included (861 patients with NP). Meta-analysis showed that there was a significant reduction in pain intensity for THC/CBD by –6.624 units ($p<0.001$), THC by -8.681 units ($p<0.001$) and dronabinol by -6.0 units ($p=0.008$) compared to placebo on a 0-100 scale. CBD, CBDV and CT-3 showed no significant changes. Patients taking THC/CBD were 1.756 times more likely to get 30% reduction in pain ($p=0.008$) and 1.422 times more likely to achieve 50% reduction ($p=0.373$) than placebo. Patients receiving THC had a 21% higher improvement in pain intensity ($p=0.005$) and were 1.855 times more likely to get 30% reduction in pain than placebo ($p<0.001$). **Conclusion**: Though THC/CBD and THC interventions provided a significant improvement in pain intensity and were more likely to provide 30% reduction of pain, evidence was moderate to low quality and the reduction in pain may not be clinically significant in the treatment of NP.

Poster #6

Title: Chronic medical conditions of Skid-Row dental patients versus national databases

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

Faculty advisor: Mehdi Mohammadi, Reyes Enciso, & Roseann Mulligan

Background: Adults with inadequate housing have high rates of chronic illnesses and overall poor health status. Little is known about the prevalence of their medical conditions upon arriving for dental treatment. **Purpose**: To compare the prevalence rate of chronic medical conditions in patients seeking dental care at two dental clinics in downtown Los Angeles Skid-Row to an age matched nationally representative sample of self-reported chronic disease data. **Methods**: Self-reported medical conditions (hypertension; congestive heart failure; previous heart attack; elevated cholesterol; previous stroke; diabetes; arthritis; asthma; cancer; and hepatitis) were extracted from records of dental patients visiting two dental clinics (the USC + Union Rescue Mission and the Center for Community Health Downtown + USC dental clinics on Skid-Row, Los Angeles during 2013-2017 years. This data was compared to NHIS and NHANES (IRB #UP-20-00044). **Results**: Adult patients attending the Skid-Row dental clinics had significantly higher prevalence of diabetes and hepatitis in all age groups and races, with diabetes being significantly higher in Hispanics ($p<0.05$) and hepatitis being significantly higher in all races ($p<0.05$), compared to the NHIS data. Our data shows significantly lower prevalence of arthritis in all ages and races from 2013-17 compared to NHANES. **Conclusions:** These findings offer statistically relevant data to show that individuals of all ages without housing who visit dental clinics at LA, Skid-Row have higher percentages of diabetes and/or hepatitis and lower arthritis than the national prevalence of these conditions in similarly aged US adults.

Poster #7

Title: Comparison of color stability in CAD/CAM and conventional denture material

Authors: Yun-Chu Chen, Sillas Duarte, & Jin-Ho Phark

Faculty advisor: Jin-Ho Phark & Sillas Duarte

Background: Good color stability of denture materials is essential to meet patients' esthetic requirements. **Purpose**: This in vitro study compared the color stability of subtractively and additively manufactured denture bases against that of conventionally heat-activated polymethyl methacrylate (PMMA) denture bases. **Methods**: A total of 135 complete denture base specimens were fabricated using three different methods (n=45 per group) and were immersed in three different solutions. Color measurement were performed by using Commission International de l'Eclairage (CIE) color parameters L*, a*, b* using a spectrophotometer at baseline, after 30-day immersion, and after re-polishing. The CIEDE2000 color difference ($\Delta E00$) was calculated, and three-way ANOVA and independent t-tests were performed ($\alpha = 0.05$). **Results**: There was significantly less color change in conventional and milled denture base compared to the 3D-printed denture base ($p<0.001$) with no significant difference between conventional and milled PMMA, and no difference in extrinsic and intrinsic color change. Overall, coffee produced more color change when compared to red wine and distilled water after 30 days of immersion period ($p<0.05$). **Conclusion**: The color stability of conventional and milled PMMA was superior to 3D-printed denture base, and milled denture bases was comparable to traditional PMMA denture base. Specimens stained with coffee had more color difference compared to red wine and water. No significant color difference in extrinsic and intrinsic color changes was found for all the materials in this study.

Poster #8

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. The waxing impression technique, which Mojmir Vacek first described in 1965, is a modification of the impression before pouring the cast. The procedure uses an adhesive wax to thicken the skirt of impression material in order to define the preparation finish line more clearly. This step also protects impression material from being torn after separating the stone cast. However, the wax shrinkage from molten to solid-phase may present a risk of impression distortion. **Purpose**: To investigate the absence or presence of distortion of the impression after using the waxing impression technique. **Methods**: Typodont teeth #8, 12, and 14 were prepared, scanned, and a standard model was printed out. Twenty PVS impressions were taken. Parafin wax, utility wax, and margin wax were used for waxing impression technique. 3D scanning of the impressions with and without waxing impression technique were compared. **Results**: There is no significant difference between PVS impressions with and without waxing impression technique use. **Conclusion**: The waxing impression technique does not affect the accuracy of the PVS final impression.

Poster #9

Title: Efficacy of ketamine on migraines and other primary headaches.

Authors: Neysan Chah, BMike Jones, Steve Milord, Reyes Enciso, & Kamal Al-Eryani

Faculty advisors: Reyes Enciso & Kamal Al-Eryani

Background: Migraine headaches are the second highest cause of disability worldwide and are responsible for significant morbidity, reduction in quality of life, and loss of productivity. **Purpose**: To evaluate the efficacy of ketamine on migraine and other primary headache disorders compared to placebo and other active interventions. **Methods**: Electronic search of databases including PubMed, EMBASE, Web of Science, and Cochrane library, along with hand searching of the references published up to February 2021, was conducted to identify randomized controlled trials (RCTs) investigating ketamine in the treatment of migraine/headache disorders compared to placebo. The authors assessed risk of bias following Cochrane handbook. **Results**: The initial search strategy yielded 398 unduplicated references, which were assessed independently by three review authors. After evaluation, this number was reduced to five RCTs (two unclear risk of bias and three high risk of bias). Due to the high risk of bias, small sample size, the heterogeneity of the outcomes reported, and the comparison groups, the evidence's quality was very low. Intranasal ketamine was superior to intranasal midazolam in improving attack severity but not duration in one RCT, while another reported intranasal ketamine was not superior to metoclopramide and diphenhydramine. In one trial, subcutaneous ketamine was superior to saline in migraine severity reduction; however, intravenous (I.V.) ketamine was inferior to I.V. prochlorperazine and diphenhydramine in another study. **Conclusion**: Further long-term studies with follow-up are needed to assess ketamine in treating acute and chronic refractory migraine using intranasal and subcutaneous routes.

Poster #10

Title: Evaluation of the printing trueness of CAD-CAM maxillary complete denture bases fabricated by using two different DLP 3D printers

Authors: Mostafa Ibrahim, Jin-Ho Phark, & Sillas Duarte

Faculty advisor: Jin-Ho Phark

Background: Computer-aided design and computer-aided manufacturing CAD-CAM systems are increasingly utilized to fabricate removable complete dentures. In contrast, Analysis and comparison of the printing trueness of complete denture bases produced by digital light processing (DLP) are lacking. **Purpose**: The aim of this in vitro study was to assess the printing trueness of CAD-CAM maxillary complete denture bases fabricated by using two different 3D printers. **Methods**: A maxillary complete denture base was digitally designed based on the virtual reference model of the maxilla which was obtained from scanning of a polyvinyl siloxane (PVS) impression of the edentulous maxilla of one patient. A total of 20 CAD-CAM maxillary complete denture bases were fabricated based on the virtual reference maxillary denture base from an ultraviolet light-curable resin material by utilizing two different Digital Light Processing (DLP) 3D printers (Asiga MAX/ MAX UV and Cara Print 4.0 printers). The intaglio and cameo surfaces of all printed complete denture bases were scanned and superimposed on the corresponding virtual reference maxillary denture base to assess the printing trueness of all printed maxillary complete denture bases using a surface matching software (Geomagic Qualify 12). Statistical analysis was conducted with two-way ANOVA and Tukey post-hoc, α=0.05. **Results**: The printing trueness of the maxillary complete denture bases fabricated by the Asiga MAX/ MAX UV printer was significantly more accurate than those fabricated by the Cara Print 4.0 printer ($p<0.001$). ANOVA test showed a significant effect of printers ($p<0.001$) and surface ($p=0.047$) with no significant interaction between printers and surface ($p=0.249$). **Conclusion**: There was a statistically significant difference in the printing trueness of CAD-CAM Maxillary complete denture bases fabricated by two different 3D DLP printers. The Asiga MAX/ MAX UV printer was more accurate than the Cara Print 4.0 printer in terms of the printing trueness of the intaglio and cameo surfaces.

Poster #11

Title: Human stem cells-based temporomandibular joint regeneration: a review

Authors: Shan Gong, Kamal Al-Eryani, Chitra Emperumal, & Reyes Enciso

Faculty advisors: Reyes Enciso & Kamal Al-Eryani

Background: Temporomandibular joint disorders (TMDs) range from functional disturbances to significant structural destructions. Traditional treatment of TMDs includes physical therapy, pharmacological, surgical, and psychological interventions. However, at the late stages of TMDs, traditional management often results in inadequate relief of symptoms. Stem cell-based tissue regeneration has been studied extensively in joint regeneration, including the Temporomandibular Joint (TMJ). **Purpose**: This study discusses the TMJ regenerative potential of various human stem cells (HSC). **Methods**: Randomized controlled trials (RCTs) and case series of TMJ regeneration (in vivo studies) and human mesenchymal stem cells (HMSC) cultured under different conditions to evaluate regeneration of TMJ related structures (in vitro studies) have been included, after a thorough search of PubMed, EMBASE, Cochrane, and Web of Science up to March 2020. The RCTs included patients with TMJ noises, pain, dysfunction, and radiological TMJ defects. **Results**: All three in vivo studies (two RCTs and one case series) showed significant improvement of TMJ pain, noises and jaw opening with stem cell transplantation compared to pre-treatment values or control groups. In vitro studies utilized a variety of stem cells, growth factors and scaffolds under different cultured conditions. Increased osteogenesis and/or chondrogenesis were noted with stem cell interventions compared to control groups on ALP activity, Col-II, Col-X, SOX9, RUNX2, LPL, and Aggrecan mRNA expression. **Conclusions**: This review emphasizes the potential of stem cell therapies

in the regeneration of TMJ-related structures. However, further in vivo RCTs are required to evaluate the efficacy and safety of these therapies in humans.

Poster #12

Title: Medications for treatment of trigeminal neuralgia compared to placebo intervention

Authors: Georgia Peterson-Houle, Magda Reda Abdel-Fattah, Reyes Enciso, & Mariela Padilla

Faculty advisors: Reyes Enciso & Mariela Padilla

Background: Trigeminal neuralgia (TN) is recognized by brief, unilateral, sharp, stabbing and shooting pains in one or more branches of the fifth cranial nerve. Treatment for TN is typically successful with medication, with surgical interventions used only as a second-line treatment modality. **Purpose**: The aim of this systematic rview and meta-analysis was to determine the effect of medications in adult patients with TN compared to placebo. **Methods**: Authors identified randomized placebo-controlled trials (RPCT) from PubMed, Web of Science, Cochrane and EMBASE up to February 2021. Studies were assessed for inclusion and exclusion criteria, as well as risk of bias based on the Cochrane handbook. **Results**: 324 unduplicated references were scanned independently and reduced to 8 relevant RPCTs with 89 patients included. Medications investigated included oral carbamazepine, subcutaneous sumatriptan, lidocaine (intranasal or 8% spray on oral mucosa or intravenous lidocaine), ganglionic local opioid analgesia, and oral Nav1.7 selective sodium channel blocker. Meta-analyses showed that overall patients receiving lidocaine reported a significantly lower post-treatment intensity of pain of -3.8 points on a 0-10 scale ($p<0.001$). Patients who had lidocaine were 8.62 times more likely to have pain improvement than patients on placebo ($p<0.001$). **Conclusion**: Due to the unclear/high risk of bias and small sample size, the quality of the evidence was low for lidocaine in the treatment of TN. Further studies are needed for carbamazepine, sumatriptan, opioids and sodium channel blockers as only one study reported outcomes.

Poster #13

Title: Oral manifestations of celiac disease: case report and literature review

Authors: Georgia Peterson-Houle, Kamal Al-Eryani, & Mariela Padilla

Faculty advisor: Kamal Al-Eryani

Background: Celiac Disease (CD) is an immune-mediated enteropathy occurring when genetically predisposed people are exposed to gluten. Atypical presentations of CD remain a challenge for the practitioner. The prevalence of recurrent aphthous ulcer and migraine headache in children before diagnosis with CD is unknown. **Purpose**: To report a case with aphthous ulcer and migraine with aura in a patient with CD. **Methods**: This is a case report of a 13 years old female with a recurrent aphthous ulcer and migraine headache with aura. These were her only symptoms prior to CD's diagnosis. A review of literature in pediatric CD was completed from 2000 to 2021. **Results**: Starting at the age of three, the patient reported canker sores, waxing, and waning in size and number. Migraine headache with aura began at age eleven. By age thirteen, the frequency and intensity of both the aphthous ulcers and migraine headaches required medical intervention. Positive serology for CD prompted a referral to a pediatric gastroenterologist to confirm the diagnosis of celiac. A gluten-free diet completely resolved the patient's symptoms. **Conclusion**: Celiac disease affects around 1% of children; however, 90% of cases are considered to remain undiagnosed. In patients with undiagnosed CD, aphthous ulcers and migraine headache may be the only presenting feature. Dentists have regular contact with children, having an opportunity to suspect CD and liaise with general medical practitioners to organize a screening for CD. Knowledge of the oral manifestations of celiac disease can change someone's quality of life.

Poster #14

Title: Post dental implant neuropathic pain management: a literature review

Authors: Mohamed Awwad, Kamal Al-Eryani, & Reyes Enciso

Faculty advisors: Kamal Al-Eryani & Reyes Enciso

Background: As dental implants become a standard procedure in general dentistry practice, the incidence of post-dental implant neuropathic pain (NP) has increased significantly. Educating general dentists in the management of post-implant neuropathies is essential to improve outcomes as early treatment is vital to prevent the condition from becoming chronic. **Purpose**: This study aims to summarize the literature and provide clinical guidelines for the general dentist to manage NP related to dental implant placement; furthermore, this study will cover the mechanism and clinical features of post-implant NP. **Methods**: A search of PubMed was performed in January 2020 to conduct a literature review. Only the articles related to the management of post-implant NP were included in this study. **Results**: 36 records were found with our electronic search, of which 22 references that focused on post-implant NP management were identified. In these references, interventions associated with significant decreases in NP intensity and improved altered sensation were classified into acute phase and chronic management. The management of acute NP involves immediate removal or shortening of the implant and glucocorticoid administration, while chronic NP management includes pharmacological treatment such as anticonvulsants, serotonin-noradrenaline reuptake inhibitors, and botulinum toxin. Other treatment modalities of care are suggested, such as acupuncture and low-level laser. Surgical intervention is indicated in progressively decreasing sensation, increasing pain, pain due to neuroma, non-improving anesthesia after 3 months, transection, and foreign body presence. **Conclusion**: This review summarized possible post-implant NP management strategies, treatment options and discussed the interventions' effectiveness.

Poster #15

Title: Presentation of temporomandibular disorders in patients with ear symptomatology

Authors: Mary Ellen Chalmers, Ramy Shams, Reyes Enciso, & Kamal Al-Eryani

Faculty advisors: Reyes Enciso & Kamal Al-Eryani

Background: The association between ear symptoms and temporomandibular joint disorders (TMD) is not widely recognized, in spite of recent systematic reviews indicating a bidirectional relationship. **Purpose**: The purpose of this study is to investigate the connections between various ear symptoms and TMD. **Methods**: This retrospective study examined 27 patients presenting with primary and secondary complaints of ear symptoms such as tinnitus (which is a continuous or intermittent ringing or buzzing in one or both ears), ear fullness, and otalgia, who were examined for temporomandibular disorders at the Orofacial Pain Clinic at USC Ostrow School of Dentistry (IRB #UP-07-00416). **Results**: The sample population was fairly evenly divided between males (56%) and females (44%). In this sample, 78% of the patients were diagnosed with tinnitus, and 30 % with ear fullness. Otalgia was reported by 70% of the patients, with symptoms in 46% being episodic and 54% continuous. TMD was present in 100% of patients, regardless of ear symptoms, diagnosed as masticatory muscle myalgias (100%) and TMJ arthralgias (89%). A high proportion of

patients (74%) had associated symptoms of headache, migraine, stress, and insomnia, and 74% also had bruxism and clenching. Other symptoms such as disc displacement (52%), neck pain (56%), and anxiety/depression (40%) were also noteworthy. Twelve patients received treatment over multiple visits, with six experiencing an improvement of ear symptoms. **Conclusions:** This retrospective study shows a 100% prevalence of TMD in patients presenting with a chief complaint of ear symptoms such as tinnitus, ear fullness, and otalgia.

Poster #16

Title: Severe bilateral mandibular condyle resorption accompanying Systemic Lupus Erythematosus: case-report

Authors: Neysan Chah & Sal Manrriquez

Faculty advisor: Sal Manrriquez

Background: Systemic Lupus Erythematosus (SLE) is an autoimmune, multisystem disease with various orofacial manifestations reported. **Purpose**: To present a case of severe bilateral mandibular condyle resorption in a patient with SLE presenting with anterior open bite and generalized mild-moderate tooth wear. Function was maintained despite severe condylar resorption. **Methods**: Review of the history, clinical and radiographical examination was carried out to determine the cause of the anterior open bite and anterior tooth wear, given the lack of anterior occlusion. **Results**: Bruxism and an acidic diet were culpable for tooth wear given the absence of other risk factors. It was determined that the anterior open bite progressively developed due to a degenerative process leading to severe bilateral mandibular condyle resorption, possibly associated with SLE directly, or indirectly due to long-term medication use, e.g., corticosteroids, and bisphosphonates. Given that the patient was asymptomatic and jaw function was within normal limits, conservative therapy including stabilization splint treatment, was used. The patient is monitored for any further mandibular condyle/temporomandibular joint (TMJ) degeneration or other signs of temporomandibular disorders (TMD). **Conclusion**: Potential mandibular condyle degeneration should be considered in patients with SLE even in the absence of pain and movement limitations typical of TMD. Management of TMJ degeneration in patients with autoimmune conditions depends upon the level of disability, deterioration, and function. It is prudent to first pursue a conservative approach along with TMJ imaging for diagnosis and future evaluation.

Poster #17

Title: The application of a high-resolution ultrasound imaging device in periodontal examination

Authors: Jane Law, Mohammed Hayati, Erin Lee, Colman Moore, Joan Beleno Sanchez, Joe Chang, Jesse Jokerst, & Casey Chen

Faculty advisor: Casey Chen

Background: Diagnosing periodontal and peri-implant diseases relies on precise clinical assessment. Clinical assessment of periodontium includes data collection of periodontal probing depths (PPD), clinical attachment loss (CAL), gingival phenotype, gingival recession, and inflammation. However, clinic examination is often time-consuming and painful for the patient, with large intra- and inter-operator variations. Ultrasound imaging technique may provide a non-invasive approach in periodontal examination. **Objective**: The objective of this study is to compare periodontal examination by ultrasound imaging and conventional clinical assessment. **Methods**: A pilot study was performed on ex-vivo pig jaws by direct examination and ultrasound imaging of the periodontal supporting structures. Subsequently, maxillary anterior and mandibular anterior sextants were examined clinically in 30 human subjects, followed by ultrasound imaging of the same sextants. **Results**: The ultrasound imaging identified marginal gingiva, cementoenamel junction (CEJ), alveolar bone crest (ABC), measured CAL, gingival recession, and gingival thickness in both the pig jaws and the human subjects. The results of periodontal examination by imaging and clinical examination were comparable. The ultrasound imaging has the advantage of providing a precise measurement of the gingival thickness and the direct visualization of the CEJ and ABC and other anatomic features underneath the gingiva. **Conclusion**: Ultrasound imaging is comparable to clinical examination and is promising as a fast, accurate, and non-invasive approach for periodontal examination.

Poster #18

Title: Impact of aging and Type-2 Diabetes Mellitus on implant treatment

Authors: Raymond Choi, Phuu Han, & Reyes Enciso

Faculty advisors: Phuu Han & Reyes Enciso

Background: Increasingly older adults in the US are seeking dental implant treatment. These individuals are also more at risk for Type 2 diabetes (T2DM). Questions have been raised as to whether implants placed in older adults and/or in patients with T2DM are likely to be successful. **Purpose**: To review the current understanding of dental implant treatment in older adults with/without T2DM. **Methods**: A PubMed electronic search of the English language literature from 1/17/2010 to 2/19/21 was conducted on implant treatment in older adults >65 years with/without T2DM followed by hand search of relevant references. **Results**: In this review, age-related physiologic and T2DM-related pathological changes important in implant treatment were assessed. When systemic diseases are in control, implant survival in older patients is comparable to younger patients. Implant survival in patients with T2DM is comparable to that of non-diabetic patients. T2DM patients with poor glycemic control show slower osseointegration and higher peri-implant tissue complications but no significant difference in implant survival compared to well-controlled patient. No specific clinical trials were identified for implant treatment in older adults with T2DM. **Conclusion**: Although dental implant treatment can be performed successfully in older adults with/without T2DM, dentists must be attentive to older patients' compromised healing capacity, adverse effects of medications as well as cognitive and social changes to improve short- and long-term implant treatment outcomes. Prospective controlled clinical studies are needed in the areas of specific glycemic control levels for older patients in order to learn how to minimize treatment complications.

CBY/ PIBBS GRADUATE STUDENTS

Poster #19

Title: An antidote to COVID-19 is xenophilia, NOT xenophobia

Authors: Smruti J. Patel, Chaeho Kim, & Simone Khouri

Faculty advisors: Joyce Sumi & Mariela Padilla

Background: The COVID-19 pandemic has affected social relationships and may have also engendered a social stigma, xenophobia. This negative relationship between a person or a group of people with certain characteristics or a specific disease can affect health and hinder access to care through discrimination. **Purpose**: To identify groups affected by xenophobia during the COVID-19 pandemic and recommendations to address it. **Methods**: A topical literature search was done in Pubmed, with the keyword "Xenophobia" for articles dated from March 2020 to March 2021. The authors selected studies related

to COVID-19 to define xenophobia and recommendations to the problem. **Results**: The initial search yield 75 articles, 46 with a direct relationship with the COVID-19 pandemic, and 31 with focused information about affected populations and specific recommendations. Ethnicity is the most common reason for xenophobia (58%), followed by suffering the disease (16%) and the migratory status (13%). Recommendations to address xenophobia are to support education and communication (41%), develop specific programs and policies (32%), and collect more data to understand the phenomena (19%). **Conclusion**: Xenophobia has been shown to have negative health consequences. It is imperative to create educational programs and policies to address this relevant issue. Further research is suggested.

Poster #20

Title: Fgfr2 regulates establishment and commitment of fontanelle progenitor cells

Authors: Lauren Bobzin & Amy Merrill

Faculty advisor: Amy Merrill

Background: 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. **Purpose**: 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. **Methods**: 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. **Results**: 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. **Conclusion**: 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 #21

Title: Investigating ameloblastin-ameloblast interactions using a novel 3D cell culture model

Authors: Gayathri Visakan, Jingtan Su, & Janet Moradian-Oldak

Faculty advisor: Janet Moradian-Oldak

Background: Ameloblastin is the second most abundant enamel matrix protein. Its silencing results in a loss of ameloblast cell polarity, and attachment to the developing matrix. **Purpose**: To develop an in vitro 3D cell culture model to examine the role of recombinant ameloblastin (rAmbn) in modulating ameloblast morphology and polarization. **Methods**: Immortalized Ameloblast Lineage Cells (ALC) were cultured in 3D using either Growth Factor Reduced Geltrex or Type I Collagen substrates for 24-72 hours. The 96 well plates were pre-coated with heat denatured rAmbn and BSA (control), rAmbn, rAmbn Δ5 and recombinant amelogenin rAmel (test samples). Cells were labeled and visualized in 3D using Keyence BZX810, and Leica confocal SP8. Aspect ratio (height/width) was measured using the BZX Image Analyzer. TCMK-1 (kidney epithelial cells) were used as control cells. **Results**: In the presence of rAmbn and rAmel, ALC clustered (surface view), and preferentially elongated along the Z axis (3D reconstruction). ALC aspect ratio was highest in the presence of rAmbn ($p<0.001$; $n=30$). Heat denaturation of rAmbn or removal of its exon 5 encoded fragment (rAmbn Δ5) abolished this effect. The morphological changes observed in 3D were specific to ALC. Immunolabeling intensity of E-cadherin, a junctional epithelium marker increased in the presence of rAmbn compared to the control. **Conclusion**: 3D culture of ALC in the presence of rAmbn leads to cytoskeletal changes as evidenced by the increased aspect ratio and expression of E-cadherin. This could suggest potential signaling roles of ameloblastin in the development of polarized ameloblasts.

Poster #22

Title: Mechanisms of craniosynostosis in Bent Bone Dysplasia Syndrome, an FGFR2 disorder

Authors: Audrey Nickle & Amy Merrill

Faculty advisor: Amy Merrill

Background: Craniosynostosis, or premature suture fusion, is one of the most common craniofacial defects and can be linked to a number of syndromic genetic disorders. One more recently characterized disorder, Bent Bone Dysplasia Syndrome (BBDS), is caused by mutations to Fibroblast Growth Receptor 2 (*FGFR2*). **Purpose**: The pattern of suture fusion in BBDS is distinct from other well-characterized FGFR2 gain-of-function mutations and our recently developed Cre driven mouse model for it provides an excellent platform to study this unique aspect of Fgfr2 signaling on suture development and maintenance. **Methods/Results**: Using the Wnt1-Cre driver mouse, we induced the $Fgfr2^{M391R}$ mutation in the neural crest cell population of the anterior skull, producing a multi-suture craniosynostosis phenotype. This was especially interesting given that several of these sutures are derived from the paraxial mesoderm rather than the neural crest. Lineage tracing with Wnt1-Cre shows, however, that there is a contribution of the neural crest to these sutures from the underlying dura mater, the outermost layer of the meninges. This suggests that signaling within this tissue is moderating fusion in our BBDS model. Using the TdTomato lineage marker, we have investigated the contribution of these cells to the mutant suture and shown that they contribute to heterotrophic bone. **Conclusion**: This, combined with analysis of the expression of the connective tissue marker Scx, furthers our hypothesis that this fusion is caused by a disruption of the balance of cells which are fated to become osteoblasts versus part of the ligament-like connective tissue of the suture. Further research will continue to investigate this and the role of Fgfr2 in these fate decisions.

Poster #23

Title: PRMT4-Runx2 signaling regulates posterior frontal suture closure

Authors: Nicha Ungvijanpunya, Yongchao Gou, Abhijit Shinde, Stephen Yen, Mark Bedford, Amy Merrill-Brugger, Yang Chai, Baruch Frenkel, & Jian Xu

Faculty advisors: Jian Xu & Stephen Yen

Background: Cranial sutures accommodate brain and skull growth during development. *RUNX2* mutation in cleidocranial dysplasia patients has been associated with open metopic suture. Runx2 is a master regulator of bone formation and its activity is regulated by multiple types of post-translational modifications. Protein arginine methyltransferase 4 (PRMT4/CARM1) is the highest expressing PRMT in osteogenic cells. However, its role in osteogenesis is unknown. **Purpose**: To investigate the role of PRMT4 in skull formation **Methods**: Neural crest cell (NCC)-specific *Prmt4* de-

letion mice were examined by skeletal preparation, microCT scanning, immunofluorescence staining, RNAScope, Proximity Ligation Assay, DiI-labeled calvaria culture and RNA-sequencing analysis. Protein methylation assays were performed in 293T cells. Migration assay and ChIP-qPCR were conducted using MC3T3-E1 cells. **Results**: We identified that PRMT4 methylated Runx2 at four arginine residues and revealed their co-expression and Runx2 methylation in osteoprogenitors at the osteogenic fronts (OF) of posterior frontal (PF) suture. NCC-specific *Prmt4* deletion caused patent PF suture. We further observed delayed osteoprogenitor migration at the OF without changing cell proliferation or apoptosis. In addition, PRMT4 depletion and methylation-deficient Runx2 impaired migration of mouse calvarial preosteoblasts. We observed a significant downregulation of ECM-related genes with enrichment in cell migration genes, and reduced Runx2 enrichment in migration gene promoters by Prmt4 deletion. We also noted downregulation of Sp7 and a subset of bone matrix genes, but the number of Runx2+ or Sp7+ cells at the OF did not decline. **Conclusion**: PRMT4-methylated Runx2 at the OF is essential for the migration of osteoprogenitors during PF suture closure.

Poster #24

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

Authors: Prerna Sehgal, Yongchao Gou, Abhijit Shinde, Baruch Frenkel, & 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 various post-translational modifications to control its activity and expression. Our lab revealed novel methylation of Runx2 by protein arginine methyltransferases (PRMTs). 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**: Cell culture osteogenic differentiation models were used to assess Runx2 methylation during differentiation. I developed dox-inducible C2C12 stable cell lines expressing Runx2 WT and methylation-deficient mutants to characterize the role of Runx2 arginine methylation in osteogenesis. I performed qRT-PCR, Alp staining and RNA-seq analysis using stable cell lines. I also conducted co-IP assays to assess interactions between methyl-Runx2 and multiple known transcriptional co-factors. **Results**: Runx2 arginine methylation was found to increase during osteogenesis model. qRT-PCR and Alp staining revealed that Runx2 WT promoted osteogenic differentiation as compared to the mutants. Runx2-dependent-methylation-dependent genes determined through RNA-seq were associated with skeletal development as the top GO pathway. Co-IP results showed that C/EBPβ binds more strongly to methylated Runx2. **Conclusion**: Runx2 arginine methylation is important for driving osteogenesis by modulating its interaction with C/EBPβ. Findings from this study will uncover new regulatory mechanism for Runx2 and potentially identify new therapeutic approaches for skeletal disease.

Poster #25

Title: Interplay between Herpes Simplex Virus 1 and Aggregatibacter actinomycetemcomitans in oral inflammation

Authors: Mehrnaz Zarinfar, Ali Savas, Tingyu Wang, Jun Zhao, Natalia Tjokro, Chao Qin, Shu Zhang, & Pinghui Feng

Faculty advisor: Pinghui Feng

Background: Periodontitis is a multifactorial and inflammatory disease that rises from a complex interaction between a broad spectrum of pathogens and host immune-inflammatory response. It is characterized by bone destruction, irreversible damage of the periodontal ligaments, and eventually tooth loss. Herpes simplex virus 1 (HSV-1) is a large DNA virus that replicates in the oral epithelium and causes cold sore. Approximately 70% are infected with HSV-1 in the general population and it reaches to 100% in individuals of 65-year and older. Recent clinical studies implicate herpesviruses in oral inflammatory diseases such as periodontitis, yet molecular mechanism by which herpesviruses contribute to oral inflammation is not understood. **Purpose**: *A. actinomycetemcomitans* is a gram-negative facultative anaerobic bacterium that is known to be associated with localized aggressive periodontitis and plays an imperative role in plaque formation and pathogenic bacterial aggregation. Bearing this in mind, we hypothesized HSV1-A.a bacterium synergism would contribute to the progression of gingivitis further to periodontitis development. **Methods**: To tackle this hypothesis, we performed an in vitro coinfection experiment using normal oral keratinocytes (NOK) cells. The co-infection of HSV-1 and A.a. resulted in loss of cell-cell junction and more cell death compared to HSV-1 or A.a bacterium infection individually. To understand the underlying mechanism of these phenotypes, we profiled protein phosphorylation via phosphopeptide enrichment with high-resolution mass spectrometry followed by bioinformatics analyses. **Results**: Interestingly through combining our results with whole cell lysate proteomics, we found that HSV1 infection, significantly altered several metabolic pathways such as lipid metabolism, and cell cycle at G2/M phase, thereby decreasing the mitotic events in infected cells. **Conclusion**: Future experiments will directly investigate the molecular events that underpin pathogenesis of bacteria-herpesvirus co-infection in oral inflammatory diseases.

Poster #26

Title: KSHV reprograms central carbon metabolism via protein deamidation during lytic replication

Authors: Mao Tian, Junhua Li, Tingyu Wang, Chao Qin, Dominique Pope, Christopher Wong, Karsten Stouffer, Deng Pan, Alireza Delfarah, Nicholas A. Graham

Faculty advisor: Pinghui Feng

Background: Though reported more than half-century ago, protein deamidation is poorly characterized for its roles in fundamental biological processes. Cellular glutamine aminotransferase (GATs), known metabolic enzymes, are capable of deamidating proteins. Utilizing KSHV infection as a model system, we probed the roles of deamidation in biological processes, specifically metabolic reprogramming. **Purpose**: We employed proteomics and metabolomics to determine the role of protein deamidation and GATs in metabolic reprogramming during KSHV lytic replication. **Methods**: To probe the role of deamidation in metabolism, we profiled the deamidation-proteomics and metabolomics of KSHV-infected oral keratinocytes that support lytic replication. Multi-omics analyses identified pathways and targets that were significantly altered by KSHV infection. Biochemical analyses, including protein interaction, deamidation, and enzyme activity, were applied to delineate protein interactions. **Results**: A robust activation in central carbon metabolism and paralleled deamidation of key central carbon metabolism enzymes was observed upon KSHV infection.

The central carbon metabolic pathways were funneled into de novo nucleotide synthesis that is primarily controlled by the glucose-6-phosphate dehydrogenase (G6PD) of the pentose phosphate pathway (PPP). KSHV exploits cellular carbomyl-phosphate synthetase, aspartate transcarbomylase and dihydroorotase (CAD), the rate-limiting enzyme of de novo pyrimidine synthesis, to deamidate and activate G6PD. As such, CAD-mediated G6PD deamidation is required for efficient KSHV lytic replication. **Conclusion**: Here, we characterized a new mechanism of metabolic reprogramming achieved via deamidation of key metabolic enzymes. Specifically, CAD deamidates G6PD to fuel the de novo nucleotide synthesis, thus uncovering new function of CAD as a driver, beyond an executor, of metabolic reprogramming.

DENTISTRY FACULTY

Poster #27

Title: Comparative analysis of student evaluation of facilitator performance

Authors: Mahvash Navazesh, Larry Eisenberg, & Nasrin Bahari Chopiuk

Background: Literature suggests that in traditional lecture-based teaching many factors such as race, gender, ethnicity, sexual orientation, stereotypes, and representations influence students' rating of their instructor's performance. These ratings are commonly perceived as indicators of the effectiveness of an instructor's teaching, and a key component in the promotion process. Less is known about the impact of the above-mentioned factors in the Problem Based Learning (PBL) pedagogy. **Purpose**: To investigate retrospectively if gender played a role in student evaluation of PBL calibrated facilitators. **Methods**: Two sets of data ranging from 2009-2019 inclusive of PBL facilitator evaluation scores (N= 53,301, male=104 and female=82, and their corresponding evaluation numbers, male =28,084 and female=25,217) and Triple Jump (T3) evaluation (N=15,368, male = 68 and female=70, and their corresponding evaluation numbers, male =7,157 and female =8,211) were used. **Results**: A two-sample t-test assuming unequal variances statistical analysis was used to test if gender plays a role in student's evaluations. Men facilitators received statistically significant higher ($p<0.011$) scores for case facilitation than women. In contrast, the T3 facilitator's scores were not significantly different ($p<0.49$) comparing men to women facilitators. However, when evaluating the p-value based on students' gender, male student evaluation of PBL facilitators ($p<0.013$) shows a significant difference rating in contrast to female students' evaluation of PBL facilitators ($p<0.082$). **Conclusion**: The pattern of findings indicates a possible association between the facilitator's gender and performance scores generated by male students. To further enhance these findings, we are currently exploring the role of additional factors such as faculty ethnicity in the evaluation process.

Poster #28

Title: Learner-centered dental admissions: 3. Implementation of an asynchronous multiple mini-interview

Authors: Anita Tourah, Robin Fox, & Mahvash Navazesh

Background: The Dental Admissions Office uses the Multi Mini-Interview (MMI) to evaluate DDS applicants on their empathy, integrity, ethical decision-making, communication, and leadership skills. Due to COVID-19 pandemic, in-person interviews could not be held. Instead, a "virtual MMI", using the Kira Talent Platform©, was developed for 2020-2021 applicant interviews. **Purpose**: An asynchronous virtual MMI initiated in October 2020 to evaluate applicants' empathy, integrity and ethical decision-making, plus their perceptual ability and writing skills. Method: Applicants were given a specific time-frame to access the platform. Once on-line, they received specific scenarios, questions to evaluate perceptual ability, and a written essay to evaluate writing skills. Applicants were videotaped verbally answering questions about the scenarios and perceptual skills. Videos of their responses, and the essay, were reviewed by calibrated evaluators. **Results**: 51 faculty, from the 6 dental divisions, and 5 staff were calibrated as MMI evaluators. Each applicant was given 7 case scenarios, 2 perceptual ability questions, and 1 essay question. Two evaluators independently rated each scenario response using a 1-5 scale. To minimize subjectivity, one evaluator scored all perceptual ability questions and one evaluator scored all essays. By early March 2021, 777 applicants were evaluated. **Conclusion**: The virtual MMI was easily incorporated into the virtual interview, and was well-received by evaluators. Further comparison of virtual interviews with traditional in-person interviews will be undertaken.

Poster #29

Title: Lipophilicity of peptide amphiphile nanofibers optimizes caveolae-mediated Wnt signaling

Authors: Yan Zhou, Erin Hsu, Samuel I. Stupp, & 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 supramolecular 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 interaction 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, metabolic inhibitor or 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. **Conclusions**: Caveolae formation is required for the potentiation of canonical Wnt signaling by PA nanofibers. Lipophilicity and conformation determine the effect of PA-mediated signaling potentiation.

DENTISTRY/ CCMB POST-DOCTORAL FELLOWS

Poster #30

Title: *Aggregatibacter actinomycetemcomitans* core and accessory genes: what do they do?

Authors: Natalia O. Tjokro, Weerayuth Kittichotirat, Roger E. Bumgarner, & 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. **Objective**: 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 #31

Title: Ameloblastin and amelogenin co-assembly and their role in mineralization

Authors: Changyu Shao, Rucha Arun Bapat, Jingtan Su, & Janet Moradian-Oldak

Faculty advisor: Janet Moradian-Oldak

Background: Amelogenin (Amel) and Ameloblastin (Ambn) are two primary extracellular matrix proteins and play critical roles in enamel formation from secretory to maturation stage. We have shown that Amel and Ambn bind together in vitro and co-localize in vivo. **Purpose**: To systematically investigate the co-assembly of Amel and Ambn and examine their cooperative effect on nucleation of calcium phosphate (CaP) in solution. **Methods**: Recombinant Ambn and Amel expressed in *E. coli* were used. We applied Atomic Force Microscopy, Dynamic Light Scattering, and Transmission Electron Microscopy to investigate their co-assembly. Nucleation of CaP was studied by monitoring the pH changes in bulk mineralization solution following addition of the proteins. **Results**: The height of Amel particles measured in-air and in-fluid onto mica was 4.31 ± 1.04 nm and 5.46 ± 0.97 nm, respectively. For Ambn particles, those values were 1.79 ± 0.28 nm and 2.62 ± 0.29 nm. The height of co-assemblies of Amel and Ambn was decreased from 5.08 ± 0.79 nm to 3.93 ± 0.94 nm in fluid following increasing ratio of Ambn to Amel, which demonstrated that Ambn and Amel co-assemble near physical conditions. Time-dependent pH changes following amorphous calcium phosphate (ACP) and hydroxyapatite (HAP) formation showed that Amel stabilized ACP for 20 minutes when Ambn stabilized ACP for 14 minutes. Low concentrations of Ambn did not affect mineral nucleation. Increasing Ambn to Amel ratio in the mineralization solution (1:100 to 1:5) promoted the kinetics of ACP to HAP transformation. **Conclusion**: Ambn and Amel co-assemble and synergically regulate transformation of ACP to HAP crystalline. We suggest that HAP crystal nucleation and phase transformation kinetics are not merely controlled by amelogenin but by cooperative effects with other enamel proteins.

Poster #32

Title: Ameloblastin contains a multitargeting domain encoded within exon 5

Authors: Natalie C. Kegulian, Ralf Langen, & Janet Moradian-Oldak

Faculty advisor: Janet Moradian-Oldak

Background: Amelogenin (Amel) and ameloblastin (Ambn) secretion by ameloblasts into the extracellular enamel space is necessary for correct formation of enamel. We reported that Ambn interacts with both Amel and membranes via a region encoded by *Ambn* exon 5. **Objectives**: To investigate the interactions of the exon 5-encoded region of ameloblastin (Ambn) with membranes, with amelogenin (Amel), and with itself, and to probe its localized structure. **Methods**: We used AB2 peptide, comprising the 37-amino-acid sequence encoded by *Ambn* exon 5, recombinant Amel, and liposomes. AB2-AB2, AB2-liposome membrane, and AB2-Amel interactions were measured using various spectroscopic techniques, culminating in electron paramagnetic resonance (EPR) with site-directed spin labeling (SDSL) to identify residue-by-residue structural changes in AB2. **Results**: Wavelength shifts in tryptophan fluorescence peaks in AB2 showed interactions with liposomes and Amel separately and when both were added to AB2 simultaneously. AB2-AB2 interactions were also observed but not when liposomes were present. Adding increasing concentrations of AB2 to liposomes led to a linear rather than exponential decrease in AB2-membrane interaction, indicating independence from AB2-AB2 interaction. EPR on spin-labeled AB2 showed a marked structural gain at residues 5, 10, 12, 19, and 24 of the peptide upon addition of liposomes but not at residue 35. Addition of unlabeled AB2 or Amel to labeled AB2 only led to slight immobilization. **Conclusions:** These experiments reveal localized structural changes in Ambn upon interaction with different targets, which may have implications for its cooperative function with Amel and its ability to adhere cell membranes to the enamel matrix.

Poster #33

Title: Amphipathic helix on ameloblastin is associated with prismatic enamel microstructure

Authors: Jingtan Su, Rucha Arun Bapat, & Janet Moradian-Oldak

Faculty advisor: Janet Moradian-Oldak

Purpose: To investigate the link between the evolution of enamel prismatic microstructure and the presence of an amphipathic helix (AH) domain within ameloblastin (Ambn). **Methods**: We utilized bioinformatics methods to analyze the presence of an AH within the sequence encoded by exon 5 of *Ambn* from species with prismatic, non-prismatic and poor prismatic enamel structure. Synthetic peptides presenting potential AH and its corresponding sequences from different species were used and their interactions with liposomes and cell membranes were investigated. ALC and LS8 ameloblast-like cells were used to examine gene expression, cell morphology and polarization following interactions with Ambn and peptides. **Results**: Fluorescent spectroscopy showed that the peptides from mammals with/without prismatic structure had blue shift in the presence of liposome indicating strong interaction. Circular dichroism revealed that the peptides from prismatic species showed increased helical content with liposomes. In contrast, the peptides from non-prismatic species didn't show such structural change following addition of liposomes. Membrane leakage showed that the peptides from prismatic species leaked the liposome. Cell spreading assay revealed that the peptides from prismatic species inhibited ALC and LS8 cells spreading on Ambn-coated plate. Addition of Ambn to LS8 cells resulted in upregulation of genes associated with cell polarization, distal

junction and Tomes' processes including ROCK1, ROCK2, PAR3, VANGL1, PRICKLE1, and VANGL2. **Conclusion**: The presence of AH on Ambn sequence is closely associated with the emergence of enamel prismatic structure. We suggest that interaction of Ambn AH with cells affects cell polarization and morphology and hence controlling enamel microstructure.

Poster #34

Title: Arid1a regulates mouse incisor homeostasis

Authors: Jiahui Du, Junjun Jing, Yuan Yuan, Jifan Feng, & Yang Chai

Faculty advisor: Yang Chai

Background: Stem cells self-renew or give rise to transit-amplifying cells (TACs) that differentiate into specific functional cell types to maintain tissue homeostasis. Arid1a performs epigenetic regulation of stage- and tissue-specific genes. However, the functional mechanism by which Arid1a influences the fate commitment of mesenchymal stem cells (MSCs) is not clear. **Purpose**: We have used the continuously growing adult mouse incisor as a model to investigate the role of Arid1a in the fate commitment of mesenchymal stem cells (MSCs) and their progeny. **Methods**: We evaluated the expression pattern of Arid1a in the incisor by immunostaining. We generated *Gli1-CreER;Arid1a*$^{fl/fl}$ mice and analyzed their incisor phenotype using notch movement analysis and H&E staining. We examined the proliferation and differentiation activity of Gli1+ MSCs and the ability of TACs to differentiate into odontoblasts after loss of Arid1a. Then, we performed RNA-sequencing, luciferase reporter assays and ChIP-qPCR analysis to investigate the functional mechanism of Arid1a. **Results**: We show that Arid1a maintains tissue homeostasis through limiting proliferation while promoting cell cycle exit and differentiation of TACs by inhibiting the Aurka-Cdk1 axis. Loss of Arid1a overactivates the Aurka-Cdk1 axis, leading to expansion of the mitotic TAC population but compromising their differentiation ability. Furthermore, the defective homeostasis after loss of Arid1a ultimately leads to reduction of the MSC population. **Conclusion**: These findings reveal the functional significance of Arid1a in regulating the fate of TACs and their interaction with MSCs to maintain tissue homeostasis.

Poster #35

Title: Arid1a regulates mouse molar root development

Authors: Jiahui Du, Junjun Jing, Yuan Yuan, Jifan Feng, & Yang Chai

Faculty advisor: Yang Chai

Background: Epigenetic remodelers often show broad expression patterns in multiple cell types yet can elicit cell-type-specific effects in development and diseases. Arid1a binds DNA and regulates gene expression during tissue development. However, it is unclear how Arid1a achieves its functional specificity in regulating progenitor cells. **Purpose**: We have used the tooth root as a model to investigate the role of Arid1a in the fate commitment and differentiation of progenitor cells during postnatal development. **Methods**: First, we examined the expression pattern of Arid1a in mouse molars by immunostaining. Then, we generated *Gli1-CreER;Arid1a*$^{fl/fl}$ mutant mice and analyzed their tooth root phenotype using CT analysis and H&E staining. We traced the cell fate of Gli1+ cells using tdTomato as a reporter and conducted RNA-sequencing, ATAC-sequencing and ChIP-sequencing analysis to investigate the functional mechanism of Arid1a. **Results**: We show that loss of Arid1a impairs the differentiation-associated cell cycle arrest of tooth root progenitors through Hh signaling regulation, leading to shortened roots. Plagl1, as a cofactor, endows Arid1a with its cell type/spatial functional specificity. Furthermore, loss of Arid1a leads to increased expression of Arid1b, which is also indispensable for odontoblast differentiation but is not involved in regulation of Hh signaling. **Conclusion**: This study expands our knowledge of the intricate interactions between chromatin remodelers, transcription factors, and signaling molecules during progenitor cell fate determination and lineage commitment.

Poster #36

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

Authors: Eva Janečková, Jifan Feng, Tingwei Guo, & Yang Chai

Faculty advisor: Yang Chai

Background: Major physiological functions such as swallowing, breathing, hearing, and speech are governed by the soft palate, and are disrupted when cleft palate occurs. Surgical correction of cleft soft palate is very challenging as it involves extensive repair of musculature. **Purpose**: To analyze canonical Wnt signaling during embryonic soft palate development, its role in regulating the interactions between cranial neural crest (CNC) and mesoderm-derived cells during this process, as well as the regulation of other organelles such as cilia, and metabolic processes such as lipogenesis. **Methods**: Histologic analyses, RNAscope, and immunofluorescence were performed on *Osr2-Cre;β-catenin*$^{fl/f}$, *β-catenin*$^{fl/fl}$, LacZ reporter mice. RNA-sequencing and qPCR analyses were conducted. **Results**: Using *Osr2-Cre;β-catenin*$^{fl/f}$ mice, we revealed the functional significance of canonical Wnt signaling in soft palate muscle development. Soft palatal muscles of *Osr2-Cre;β-catenin*$^{fl/f}$ mice were significantly reduced in size, indicating the necessity of Wnt signaling for CNC-derived mesenchymal cells to regulate soft palate myogenesis. RNA-sequencing analysis revealed that genes associated with muscle development (*Myog, Myod1*) had decreased expression in *Osr2-Cre;β-catenin*$^{fl/f}$ mice, in contrast to increased expression of genes connected to ciliogenesis *(Ift88, Ttll6*) and lipogenesis *(Cds1, Pde8b*). **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 progenitor cells. Our results also highlight the roles of mesenchymal Wnt signaling-regulated ciliogenesis and lipogenesis, which when disrupted ultimately lead to defective soft palatal muscle development. These results may contribute to improved treatment of cleft soft palate.

Poster #37

Title: Cerebral organoid and mouse models reveal a RAB39b–PI3K–mTOR pathway-dependent dysregulation of cortical development leading to macrocephaly/autism

Authors: Wei Zhang, Li Ma, Mei Yang, Qiang Shao, Jian Xu, Zhipeng Lu, Zhen Zhao, Rong Chen, Yang Chai & 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 overproliferation 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 overproliferation 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 #38

Title: Deletion of PRMT1 Protects against TAC-Induced cardiac ventricular dysfunction

Authors: Jiang Qian, Nicha Ungvijanpunya, Prerna Sehgal, & Jian Xu

Faculty advisor: Jian Xu

Cardiac fibroblast and its programmed activation into myofibroblasts critically regulate myocardial extracellular matrix (ECM) homeostasis. Our lab recently identified PRMT1 as a new regulator for cardiac fibroblasts differentiation to myofibroblasts in cardiac remodeling. We generated a Prmt1 knockout mouse model using a myofibroblast-specific inducible Cre-line, *PnMC-M^{+}:Prmt1$^{flox/flox}$:R26R$^{YFP/YFP}$* (experimental group) and *Prmt1$^{flox/flox}$:R26R$^{YFP/YFP}$* (control group) mice, and performed TAC surgery to induce cardiac injury and remodeling. We found 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 TAC, comparing with controls. We also identified that siRNA-mediated knock-down of PRMT1 altered histone methylations in TGFb-stimulated cardiac fibroblasts, suggesting a possible role of PRMT1 in fibroblasts fate transition. Furthermore, injection of PRMT1 inhibitor MS023 successfully rescued TAC-induced cardiac failure in wild type mice, comparing with vehicles, indicating PRMT1 as a promising target in chronic heart failure treatment.

Poster #39

Title: Inhibition of hedgehog signaling in Gli1+ osteogenic progenitors alleviates osteoarthritis

Authors: Jie Lei, Shuo Chen, Junjun Jing, Jifan Feng, Tingwei Guo, Yuan Yuan, Xia Han, Thach-Vu Ho, & Yang Chai

Faculty advisor: Yang Chai

Background: Recent studies suggest that committed osteoblastic lineage of bone marrow mesenchymal stem cells (BMMSCs) in the subchondral bone may involve in the development of OA, but the exact mechanism remains to be elucidated. In this study, we identified Gli1+ cells as unique osteogenic progenitors in mandibular condyle and further investigated the role of Gli1+ cells in OA. **Purpose**: To investigate the role of Gli1+ osteogenic progenitors in TMJOA. **Methods**: We generated *Gli1-CreERT2;tdTomato* for lineage tracing experiments and *Gli1-CreERT2;Smofl/fl;tdTomato*, in which Smo was deleted in the Gli1+ lineage. A mouse model with OA-like changes in the TMJ was induced by partial discectomy (PD). Micro-CT, HE staining, immunofluorescence staining and RNA-seq were conducted for analyses. **Results**: Lineage tracing results showed that Gli1+ cells in the subchondral bone were osteogenic progenitors in mandibular condyle. In PD-induced TMJOA model, we observed abnormal subchondral bone remodeling through expansion of Gli1+tdTomato+ cells along with increased but uneven osteoblastic differentiation. RNA-seq analysis and in vivo validation revealed hedgehog (HH)-Gli1 signaling was upregulated in the subchondral bone of TMJOA mice. Inhibition of HH signaling in Gli1+ cells alleviated abnormal subchondral bone remodeling and articular cartilage degeneration. **Conclusions:** Gli1+ cells are osteogenic progenitors for condylar subchondral bone formation and homeostasis in the mouse mandible. In PD-induced TMJOA model, expansion of Gli1 progeny due to HH signaling upregulation may negatively affect subchondral bone remodeling. Furthermore, inhibition of HH signaling in Gli1+ osteogenic progenitors could alleviate TMJOA, suggesting a potential cellular target for future therapeutics in treating patients with TMJOA.

Poster #40

Title: Kdm6b and Ezh2 antagonistically regulate p53 signalling to control palatogenesis

Authors: Tingwei Guo, Xia Han, Jizhi He, Jifan Feng, Junjun Jing, Eva Janeckova, Thach-Vu Ho, Jian Xu & Yang Chai

Faculty advisor: Yang Chai

Background: Epigenetic regulation plays a crucial role in development and diseases. Disruption of epigenetic regulation not only increases the risk of cancer, but can also cause developmental defects. However, it is still unclear how epigenetic regulators coordinate with a transcriptional network to regulate the morphogenesis of specific organs. **Purpose**: To investigate the potential roles of Kdm6b as an epigenetic regulator in organogenesis. **Methods**: The transgenic mouse model used in this study is *Wnt1-Cre;Kdm6b$^{fl/fl}$*, in which Kdm6b was deleted in cranial neural crest-derived cells. Cellular and molecular experiments used in this study included immunohistochemistry, in situ hybridization (RNAscope), CoIP, RNA-seq, ATAC-seq and ChIP-qPCR. **Results**: Using palatogenesis as a model, we revealed the functional significance of Kdm6b, a H3K27me3 demethylase, in regulating embryonic development. Kdm6b played an essential role in neural crest development, and loss of Kdm6b resulted in complete cleft palate and soft palatal muscle defects. Cell proliferation and differentiation were abnormal in *Wnt1-Cre;Kdm6b$^{fl/fl}$* mice. Importantly, the antagonistic interaction between Kdm6b and Ezh2 in regulating H3K27me3 was crucial for p53 expression in cranial neural crest cells during embryogenesis. Furthermore, the transcription factor Tfdp1 was recruited to the promoter of p53 along with Kdm6b to specifically activate p53 expression during palatogenesis. **Conclusions**: Our study highlights the important role of the epigenetic regulator Kdm6b and how it cooperates with Tfdp1 to achieve its functional specificity in regulating p53 expression, and provides mechanistic insights into the epigenetic regulatory network during organogenesis.

Poster #41

Title: Mapping mouse molar development at single cell resolution

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

Faculty advisor: Yang Chai

Objectives: We aim to identify the heterogeneity among odontogenic cell populations during mouse molar development and elucidate their differentiation trajectories. **Methods**: Molars of wildtype mice at E14.5, E16.5 and PN3.5 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 and RNAscope were performed to validate the gene expression profiles. Lineage tracing analyses were conducted to

demonstrate the differentiation trajectories. **Results**: We have revealed several new cell types in the dental mesenchyme of mouse molars. Our results showed that there were distinct cellular domains within the mouse molar during development. We found that dental papilla and follicle lineages start to appear at E14.5. Odontoblast lineage was observed as early as E16.5. Interestingly, we found that two distinct cell populations within the dental follicle at PN3.5, which can both contribute into periodontal tissue. Surprisingly, our data suggested that Ki67+ cycling cells at PN3.5 may serve as progenitor cells contributing to root complex formation. **Conclusions:** Our study provides comprehensive information about the cellular heterogeneity and differentiation of dental cell populations in mouse molars and the findings in this study may lead to new strategies for tooth regeneration in the future.

Poster #42

Title: Real-time monitoring of osteomyelitis biofilm pathogens with novel bisphosphonate-antibiotic conjugates

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

Faculty advisor: Parish P. Sedghizadeh

Background: *Staphylococcus aureus* is a predominant cause of biofilm-associated infections, including serious infections such as osteomyelitis. To address issues with current antimicrobial therapeutics in osteomyelitis treatment, we have designed, synthesized, and tested novel BP-fluoroquinolone antibiotic conjugates for activity against *Staph aureus* bone biofilms. **Purpose**: To study the real-time development and inhibition of *Staph aureus* biofilms with novel bone-targeting antimicrobial conjugates. **Methods**: Monitoring of biofilm formation and inhibition was performed with an impedance based real-time cell analyzer. The following antibiotics were tested: ciprofloxacin (C), moxifloxacin (X), sitafloxacin (S), and nemonoxacin (N). The following novel experimental conjugates were synthesized and tested: bisphosphonate-carbamate-sitafloxacin, bisphosphonate-carbamate-nemonoxacin (BCN), etidronate-carbamate-ciprofloxacin (ECC), and etidronate-carbamate-moxifloxacin (ECX). MIC and biofilm preventative assays were performed, and HPLC was used to assess hydroxyapatite binding affinity of conjugates. **Results**: HPLC results indicate that conjugates have high binding affinity and retention to HA in comparison to unconjugated antibiotics. Parent antibiotics and the tested conjugates were effective in inhibiting biofilm formation in impedance assays. Sitafloxacin and nemonoxacin demonstrated the lowest MIC values. The conjugate with the lowest and most favorable MIC profile was BCN, followed by BCS, with the etidronate conjugates demonstrating the highest MIC profiles. **Conclusions**: Results show that real-time biofilm analysis can be a promising tool to evaluate antibiotic susceptibility and efficacy in biofilm-mediated infections. 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 #43

Title: Reciprocal interaction between MSCs and TACs regulates tissue homeostasis

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

Faculty advisor: Yang Chai

Objectives: In multiple organs, mesenchymal stem cells (MSCs) give rise to transit amplifying cells (TACs), which then differentiate into different cell types. We aim to identify whether and how MSCs interact with TACs to regulate tissue homeostasis. **Methods**: Incisors of wildtype and different mutant mice at adult stage were harvested and histological analysis was conducted. Laser capture followed by RNA sequencing was performed from *Axin2-Cre^{ER};tdT* and *Gli1-Cre^{ER};tdT* incisors and bioinformatics analysis was utilized to identify the enriched signaling in MSCs and TACs. RNAscope staining combined with immunostaining were performed to confirm the gene expression pattern. **Results**: We have revealed that TACs and MSCs have distinct genetic programs and engage in reciprocal signaling cross talk to maintain tissue homeostasis. Specifically, an IGF-WNT signaling cascade is involved in the feedforward from MSCs to TACs. TACs are regulated by tissue-autonomous canonical WNT signaling and can feedback to MSCs and regulate MSC maintenance via Wnt5a/Ror2-mediated non-canonical WNT signaling. **Conclusions:** Our study highlight the importance of coordinated bidirectional signaling interaction between MSCs and TACs in instructing mesenchymal tissue homeostasis, and the mechanisms identified here have important implications for MSC-TAC interaction in other organs.

Poster #44

Title: Reversing social memory deficit in mice exposed to maternal Zika virus infection

Authors: Li Ma, Jianlong Ge, Yuan Wang, & Jian-Fu Chen

Faculty advisor: Jian-Fu Chen

Zika virus (ZIKV) infection during pregnancy is causatively linked to a wide range of developmental brain disorders. Related structural defects in the brain such as microcephaly have been characterized. Emerging evidence suggests that infants who are asymptomatic at birth might have neurocognitive complications that compromise quality of life later on. However, animal models predicting and recapitulating these cognitive phenotypes are lacking, and the circuit mechanism underlying behavioral abnormalities is unknown. Here we found that ZIKV infection during mouse pregnancy leads to autistic-like behaviors including repetitive self-grooming and impaired social memory in offspring. We found structure alteration in the synaptic connections and pattern of vHIP innervation of mPFC neurons, leading to hyperconnectivity of vHIP-mPFC pathway. Decreasing the activity of mPFC-projecting vHIP neurons with a chemogenetic strategy rescued social memory deficits in ZIKV offspring mice. Our studies developed a new mouse model of neurocognitive abnormalities and identified hyperconnectivity of vHIP to mPFC projections driving social memory deficits in offspring with maternal ZIKV infection.

Poster #45

Title: Sensory nerves support adult stem cell homeostasis via FGF signaling

Authors: Fei Pei & Yang Chai

Faculty advisor: Yang Chai

Background: Stem cell niche provides a microenvironment to support the self-renewal and multi-lineage differentiation of stem cells. The mouse incisor is a highly innervated microenvironment with sensory nerves. However, the mechanism by which sensory nerves regulate adult stem cell homeostasis is still unclear. **Methods**: *Advillin-CreER;tdTomato* and *Advillin-CreER;DTA* mice were used to explore the role of sensory nerve. ScRNAseq of the trigeminal ganglion was performed to analyze the secreted ligands of sensory nerve. To further explain how the sensory nerve regulates MSCs, expression of different FGF receptors were analyzed in the incisor. *Gli1-CreER;Fgfr1$^{f/f}$* mice were generated to explore how FGF1 secreted from the sensory nerve regu-

lates stem cells in adult mouse incisor tissue homeostasis. **Results**: Advillin is expressed in the trigeminal ganglion, inferior alveolar nerve and nerves in the incisor, as shown by *Advillin-CreER;tdTomato* tracing. There was abnormal dentin formation and a reduced incisor growth rate following the induced defect in sensory nerve in *Advillin-CreER;DTA* mice. Furthermore, there was a compromised label-retaining cells and cell proliferation in *Advillin-CreER;DTA* mice. Sc-RNAseq revealed different clusters of cells and indicated that sensory nerve secretes FGF1, which exhibits high expression in the proximal region of the incisor. Fgfr1 was detected in Gli1+ mesenchymal stem cells both in vivo and in vitro. Loss of Fgfr1 in Gli1+ cells showed a similar phenotype to that of *Advillin-CreER;DTA* mice. **Conclusions**: Sensory nerves secrete FGF1 ligand, which interacts with MSCs in the incisor by binding with specific receptor FGFR1 to regulate tissue homeostasis in adult mouse incisor.

Poster #46

Title: Spatiotemporal cellular movement and fate decisions during mandibular arch morphogenesis

Authors: Yuan Yuan, Yonghwee Eddie Loh, Xia Han, Jifan Feng, Thach-Vu Ho, Jinzhi He, Junjun Jing, Kimberly Groff, Alan Wu, & Yang Chai

Faculty advisor: Yang Chai

Background: Cranial neural crest (CNC) cells contribute to different cell types during embryonic development. It is unknown whether postmigratory CNC cells undergo dynamic cellular movement and how the process of cell fate decision occurs within the first pharyngeal arch (FPA). **Purpose**: From a developmental perspective, it is fascinating to investigate the dynamic processes through which postmigratory CNC cells commit to different fates and subsequently give rise to a variety of structures within the craniofacial complex. **Methods**: In this study, we investigated cellular heterogeneity during early mandible development and refined and mapped patterning domains with distinct differentiation potential back into the FPA in fine detail. We also transcriptionally profiled single cells from critical developmental stages, closely tracked CNC cells within the FPA. **Results**: Our investigations demonstrate notable heterogeneity within the CNC cells, refine the patterning domains, and identify progenitor cells within the FPA. These progenitor cells undergo fate bifurcation that separates them into common progenitors and mesenchymal cells, which are characterized by Cdk1 and Spry2/Notch2 expression, respectively. The common progenitors undergo further bifurcations to restrict them into osteogenic/odontogenic and chondrogenic/fibroblast lineages. Disruption of a patterning domain leads to specific mandible and tooth defects, validating the binary cell fate restriction process. **Conclusion**: Different from the compartment model of mandibular morphogenesis, our data redefine heterogeneous cellular domains within the FPA, reveal dynamic cellular movement in time, and describe a sequential series of binary cell fate decision-making process.

Poster #47

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

Authors: Jifan Feng, Xia Han, Yuan Yuan, Courtney Kyeong Cho, Eva Janeckova, Tingwei Guo, Jing Bi, Mingyi Zhang, Thach-Vu Ho, & 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;Alk5f$^{fl/fl}$* 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;Alk5f$^{fl/fl}$* 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;Alk5f$^{fl/fl}$* 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;Alk5f$^{fl/fl}$* 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;Alk5f$^{fl/fl}$* 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 #48

Title: Virtual treatment planning of surgery-first orthognathic approach using reverse engineering

Authors: Jaemin Ko, Lamia Alhuwaishel, Xuanyu Lu, Mark M. Urata, Jeffrey A. Hammoudeh, & Stephen L.-K. Yen

Faculty advisor: Stephen Yen

Background: Over the past few decades, the surgery-first approach has become a popular method in orthognathic surgery. With the surgery-first approach, there is a change in treatment sequence. The occlusion immediately after surgery is not in an ideal position, and clinicians have to determine what this temporary malocclusion, which is called transitional occlusion, should look like during the planning process. The proper transitional occlusion is the key to successful postsurgical orthodontic treatment as it ensures an ideal final occlusion. **Purpose**: Finding the best way to determine the proper transitional occlusion for the surgery-first cases using virtual planning. **Methods**: For prediction of orthognathic surgery and postsurgical orthodontic treatment, 3D virtual treatment planning was performed using virtual planning software (Nemotec). The treatment planning consisted of 3 steps. For step 1, teeth were virtually setup to achieve the ideal position. In step 2, maxilla and mandible with setup dentition were virtually repositioned. In step 3, setup dentition was switched back to the original dentition while maintaining the skeletal positions. The ideal position of transitional occlusion was determined through this process. **Results**: Two surgery first cases were planned with described virtual treatment planning method. Both of them were successfully treated as planned. **Conclusion**: A multiplatform software can be a powerful tool for analyzing problems in finishing a surgery-first case, predicting outcomes and improving the accuracy in planning surgery-first approach.

Poster #49

Title: Runx2 maintains the mouse incisor mesenchymal stem cell niche

Authors: Shuo Chen, Junjun Jing, Thach-Vu Ho, & 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-Cre^{ERT2};Runx2$^{fl/fl}$* mice, in which Runx2 was 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. **Conclusions:** Loss of Runx2 in Gli1+ cells affects the IGF signaling pathway, which regulates TAC proliferation as well as differentiation.

Poster #50

Title: Lhx6 is required for mouse root patterning

Authors: Jinzhi He, Jifan Feng, Tingwei Guo, Yuan Yuan, & 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-Cre^{ER}, ROSA26l$^{oxP\text{-}STOP\text{-}loxP}$-tdTomato, Gli1-LacZ, and Gli1-Cre^{ER}*. MicroCT, HE staining, immunofluorescence, RNAscope and bulk-RNAseq were used. **Results**: Lhx6, an in vivo maker 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 #51

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

Authors: Yuanyuan Ma, Junjun Jing, Quan Wen, Jingyuan Li, & 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 #52

Title: Cranial suture regeneration and cognitive improvement in a craniosynostosis model

Authors: Mengfei Yu, Li Ma, Yuan Yuan, Jian-fu Chen, & 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. **Con-**

clusions: 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 #53

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, & 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 #54

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, & 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-KIcre; 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-KIcre; 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-KIcre; 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 #55

Title: *Aggregatibacter actinomycetemcomitans* activates MHV68 lytic replication via synergistically stimulating ISG15 expression

Authors: Jianglin Zhang, Casey Chen, & Pinghui Feng

Faculty advisor: Pinghui Feng & Casey Chen

Background: Advanced periodontitis (deep periodontal pockets ≥6 mm) affects 10% to 15% of adults worldwide, contributing significantly to the global burden of oral diseases. Clinical association studies show that ongoing herpesvirus infection is associated with severe forms of oral diseases, such as severe periodontitis. How herpesviruses contribute to oral inflammatory diseases is not understood. **Purpose**: The goal of this study is to characterize bacteria-virus interaction in the oral inflammatory diseases using gamma herpesvirus 68 (MHV68) and *Aggregatibacter actinomycetemcomitans* (A.a.) as a model. **Methods**: Here we used oral keratinocytes to determine the interaction between MHV68 and A.a. in host response and microbial infection. **Results**: Co-infection of MHV68 and A.a. enhanced the production of CXCL10, a chemokine biomarker of periodontitis development, and the expression of ubiquitin-like protein ISG15 (interferon-stimulated gene 15), a protein potentially conjugated to substrate proteins to regulate their biological functions. This post-translational modification is known as protein ISGylation. Our data showed that co-infection of MHV68 and A.a. elevated protein ISGylation in mouse embryonic fibroblasts (MEFs) compared with MHV68 or A.a. infection alone. We further showed that MHV68 lytic replication was reduced in ISG15 knockout MEFs compared to WT MEFs, indicating that ISG15 and ISGylation stimulated by MHV68 and A.a. co-infection promote MHV68 lytic replication. **Conclusion**: Collectively, A.a. positively regulates MHV68 lytic replication via enhancing the expression of ISG15 and ISGylation.

Poster #56

Title: Viral glutamine amidotransferase (vGAT) activates phosphoribosyl-formylglycinamidine synthetase (PFAS) to fuel de novo purine synthesis and tumorigenesis

Authors: Ting-Yu Wang, Xiaoxi Lin, Junhua Li, Simin Xu, & Pinghui Feng

Faculty advisor: Pinghui Feng & Casey Chen

Background: Kaposi's sarcoma-associated herpesvirus (KSHV) is a tumorigenic DNA virus linked to several malignancies such as Kaposi's sarcoma and pleural effusion lymphoma. Recent studies have reported that viruses can activate cellular metabolism to promote lytic replication and tumorigenesis. However, the molecular mchanism concerning such virus-induced metabolic reprograming is still not well understood. **Purpose**: This study aims to delineate the molecular mechanism by which a viral pseudoenzyme activates the de novo purine synthesis to promote tumorigenesis. **Methods**: Methods for this study include: 1) Cell culture and transfection, 2) Immunoblotting and immunoprecipitation, 3) Metabolites extraction and liquid chro-

matography-mass spectrometry (LC-MS) analysis, 4) In vivo tumor formation, and 5) Quantification and statistical analysis. **Results**: 1. The vrial pseudoenzym, vGAT increases production of purine metabolites such as IMP, inosine, hypoxathine and guanosine in human oral keratinocytes (HOK) cells, indicating that vGAT expand nucleotide metabolim pool to fuel cell proliferation through stimulating de novo purine synthesis. 2. vGAT binds to purine-synthesis enzymes, including phosphoribosyl pyrophosphate amidotransferase (PPAT) and PFAS, suggesting that vGAT may alter their enzyme activity in purine synthesis. 3. Nude mice injected with NIH3T3/vGAT developed visible tumors in three weeks, suggesting vGAT contributes potentially to virally associated malignancies. **Conclusion**: Our findings support the hypothesis that KSHV vGAT pseudoenzyme can boost the de novo purine biosynthesis by interacting with PPAT and PFAS, and also imply that elevated purine synthesis, perhaps with other metabolic pathways, can drive tumorigenesis. This hypothesis will be further investigated.

Poster #57

Title: Targeting CTP synthetase 1 to restore interferon induction and deplete nucleotides in SARS-CoV-2 infection

Authors: Youliang Rao, Ting-Yu Wang, Qizhi Liu, Bianca Espinosa, Chao Qin, Jun Zhao, Arunika Ekanayake, Ali Can Savas, Shu Zhang, Mehrnaz Zarinfar, Yongzhen Liu, Wenjie Zhu, Nicholas Graham, Taijiao Jiang, Chao Zhang, & Pinghui Feng

Faculty advisor: Pinghui Feng

Background: The newly emerged SARS-CoV-2 caused a global pandemic with astonishing mortality and morbidity. To propagate in infected cells, viruses evolved strategies to evade host innate immune system and exploit cellular machinery to synthesize macromolecules and biomaterials to fuel viral replication. However, how SARS-CoV-2 interacts with innate immune system and modulates cellular metabolism remains poorly understood. **Purpose**: The purpose of this study was to investigate the mechanism that SARS-CoV-2 evades host innate immune defense, while promoting macromolecule synthesis. **Methods**: We performed biochemical analyses to define virus-host interactions by co-immunoprecipitation assays, two-dimensional gel electrophoresis, innate immune response by real-time PCR and ELISA, viral replication by real-time PCR and plaque assay, and metabolite profiling by liquid-chromatography coupled with mass spectrometry. **Results**: We found that SARS-CoV-2 exploits CTPS1 to promote CTP synthesis and suppress IFN induction. Screening a SARS-CoV-2 expression library identified ORF7b and ORF8 that suppressed IFN induction via inducing the deamidation of interferon regulatory factor 3 (IRF3). Deamidated IRF3 fails to bind the promoters of classic IRF3-responsible genes, thus muting IFN induction. ORF7b and ORF8 also activate CTPS1 to promote CTP synthesis. De novo synthesis of small-molecule inhibitors of CTPS1 enabled CTP depletion and IFN induction upon SARS-CoV-2 infection, thus impeding SARS-CoV-2 replication. **Conclusion**: Our work uncovers a strategy that a viral pathogen couples immune evasion to metabolic activation to fuel viral replication. Inhibition of the cellular CTPS1 offers an attractive means for developing antiviral therapy that would be resistant to SARS-CoV-2 mutation.

Poster #58

Title: Targeting a pyrimidine synthesis enzyme to restore inflammatory cytokine production and deplete pyrimidine in SARS-CoV-2 infection

Authors: Chao Qin, Hao Yuan, Youliang Rao, Ting-yu Wang, Jun Zhao, Ali Savas, Bianca Espinosa, Chao Zhang, & Pinghui Feng

Faculty advisor: Pinghui Feng

Background: Although ongoing vaccination drastically reduces SARS-CoV-2 infection, mutant viruses are emerging under the pressure of neutralizing antibodies, calling for new antiviral strategies. Here, we report the development of a small molecule inhibitor that targets the rate-limiting enzyme, CAD, of the de novo pyrimidine synthesis pathway to restore inflammation and deplete pyrimidine in SARS-CoV-2-infected cells, thus impeding viral replication. **Purpose**: The goal of this study is to characterize a novel viral immune evasion strategy that the emerging SARS-CoV-2 hijacks CAD to deamidate RelA, thereby shutting down NF-kB activation and inflammatory cytokine production. Inhibition of CAD is expected to restore cytokine production and deplete pyrimidine in SARS-CoV-2-infected cells, thus impeding viral replication. **Methods**: In this study, we used real-time PCR, western blot, liquid chromatograph-mass spectrometry, viral titer determination, co-immunoprecipitation, gene expression analysis, and protein charge analysis by two-dimensional gel electrophoresis (2DGE). **Results**: To test our central hypothesis, we discovered that SARS-CoV-2 infection induced weak expression of inflammatory cytokines and that it hijacks CAD to deamidate RelA to inhibit NF-kB activation. Indeed, SARS-CoV-2 activated CAD and depletion of CAD restored NF-kB activation. Screening a SARS-CoV-2 expression library, we identified Nsp9 that interacted with CAD and inhibited NF-kB activation. Conversely, activated CAD upregulated the pentose phosphate pathway (PPP), the de novo synthesis of nucleotides and Nsp9 upregulated the PPP in a CAD-dependent manner. Biochemical and metabolites analysis indicated that CAD, when activated, deamidated and activated glucose-6-phosphate dehydrogenease (G6PD), the first rate-limiting enzyme of PPP, to fuel de novo nucleotide synthesis. De novo synthesis of a small molecule inhibitor of CAD enabled the restoration of inflammatory cytokine and depletion of nucleotides in SARS-CoV-2-infected cells. Ongoing study is examining the antiviral effect of the small molecule on SARS-CoV-2 infection and disease in mice. These results uncover an intricate strategy whereby SARS-CoV-2 couples inhibition of inflammatory cytokine production to activated nucleotide synthesis. **Conclusion**: Our work reveals that SARS-CoV-2 can hijack CAD to block NF-kB activation and upregulate PPP through deamidating RelA and G6PD respectively. Our new-designed drug 2-TCPA can target CAD to diminish SARS-CoV-2 replication dramatically. 2-TCPA is a promising antiviral drug for the therapy of COVID-19 patients.

Poster #59

Title: SARS-CoV-2 Nsp5 targets RIG-I and MAVS to inhibit IFN induction

Authors: Yongzhen Liu, Youliang Rao, Chao Qin, Chau Ngo, Jun Zhao, Shu Zhang, Ting-Yu Wang, Mao Tian, Ali Can Savas, Mehrnaz Zarinfar, Hanging Yang, Julio A Camarero Palao, Xiaojiang Chen, Chao Zhang, & Pinghui Feng

Faculty advisor: Pinghui Feng

Background: Caused by the newly emerged SARS-CoV-2, the COVID-19 pandemic claimed more than 132 million known infections and 2.8 million deaths, leaving many unknown infections. The high replication and transmission of SARS-CoV-2 are remarkably distinct to previous closely related coronaviruses and underpinning molecular mechanisms remain unclear. Innate immune defense is a physical barrier to restrict viral replication. **Purpose**: Previous studies on SARS-CoV and MERS-CoV have identified diverse viral factors that modulate host innate immune response. By comparing the SARS-CoV-2 genome sequence to those of SARS-CoV and MERS-CoV, a number of viral proteins were predicted to exert similar function to meddle cellular innate signaling events. However, the actual viral proteins and

their mechanisms of action of SARS-CoV-2 remain to be defined. **Methods**: A screen utilizing the SARS-CoV-2 expression library identified Nsp5 as a potent inhibitor of IFN induction and that Nsp5 targets both RIG-I and MAVS for destruction. **Results**: Specifically, Nsp5 cleaves off the very N-terminal 10 amino acids from RIG-I and deprives it to activate MAVS. Furthermore, Nsp5 promotes the ubiquitination and proteosome-mediated degradation of MAVS. As such, Nsp5 potently inhibits IFN induction by dsRNA in an enzyme-dependent manner. A synthetic small molecule inhibitor blunted Nsp5-mediated destruction of RIG-I and MAVS and restored antiviral IFN induction, thereby impeding SARS-CoV-2 replication. **Conclusion**: This work offers new insight into the immune evasion strategy of SARS-CoV-2 and provides an antiviral agent for treating COVID-19 patients.

UNDERGRADUATE & DDS STUDENTS - BASIC SCIENCES

Poster #60

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

Authors: Maile Osborne, Piedad Suarez-Durrall, Reyes Enciso, & Roseann Mulligan

Faculty advisors: Piedad Suarez-Durall, Reyes Enciso, & Roseann Mulligan

Background: Over 40% of older adults have chronic pain that is usually treated with long-term opioid use, risking drug dependence, increased risk of injury, and emergency department visits or death. **Purpose**: To examine opioid prevalence in patients >65 years of age within a dental school clinic, compared to national data. **Methods**: Self-reported opioid use was extracted from the medical records for patients >65 years old visiting our dental school in 2012 or 2017. This data was then compared to the National Health and Nutrition Examination Survey (NHANES) data for 2011-2012 and 2017-18. **Results**: In our sample there was a significant increase in the prevalence of self-reported opioid use between 2017 (6.5%) and 2012 (4.5%; $p<0.01$) and in all ages, female gender, and African Americans (all at $p\leq0.05$). For the NHANES population opioid usage also increased between 2012 to 2017 in all ages, females and Caucasians (no significant differences) but decreased significantly in Hispanics ($p\leq0.05$) with a decreasing trend in African Americans. When compared, older adults at our clinic reported less opioid use than the NHANES population in both periods no matter the gender, with the exception of those aged >80 and Hispanics in 2017 (both having non-significant differences). **Conclusions:** The prevalence of older adults taking opioids in our dental school clinic increased significantly in 2017 when compared to 2012. Practicing dentists should be aware of the risks associated with opioid use in older adult patients and consider prescribing alternative analgesics following the CDC guidelines and ADA policy.

Poster #61

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

Authors: Aileen Ghobadi, Katerine Scheker, Ilan Kaboud, Eva Janečková, & 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 tissue 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 stem cell niche microenvironment. **Purpose**: To explore the largely unknown signaling network that guides the fate of MSCs as well as their niche in the mouse incisor. **Methods**: RNAscope, immunofluorescence, and histological analysis were performed on *Gli-Cre^{ER};Tgfbr2$^{fl/fl}$* and *Gli-Cre^{ER};Smo$^{fl/fl}$* conditional knockout mice and *Gli1-LacZ* reporter mice. **Results**: Both *Gli-Cre^{ER};Smo$^{fl/fl}$* and *Gli-Cre^{ER};Tgfbr2$^{fl/fl}$* mice display impaired odontogenesis two months after tamoxifen injection; their dentinogenesis and amelogenesis are increased. The proliferation activity in the area of the 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-Cre^{ER};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 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 #62

Title: Targeted delivery of antimicrobial peptides in peri-implantitis

Authors: Natalia O. Tjokro, Christie Shen, Candan Tamerler, Malcolm L. Snead, & Casey Chen

Faculty advisor: Casey Chen

Background: Peri-implantitis is a host-mediated inflammatory response to dysbiotic biofilms on the implants that leads to bone loss and implant failures. Here we used a predictive approach to peptide design to engineer bifunctional peptides to combat bacterial colonization and biofilm formation on implants. This bifunctional peptide contains a titanium-binding domain that recognizes and binds titanium implant surfaces, fused through a rigid spacer domain with an antimicrobial domain. The antimicrobial activity of these peptides to common oral pathogens and commensals remains to be determined. **Objective**: To determine the effectiveness of antimicrobial peptides (AMPs) in the eradication of common periodontal pathogens and reduction of biofilm formation. **Methods**: Bacterial suspensions at 107 CFU/ml were treated with 100 μM of AMPs, and bacterial viability were determined at different time points by CFU counts. AMPs were also added to 24-hour single-species and poly-microbial biofilms, and biofilms were quantified through crystal violet staining. **Results**: Our preliminary results showed that AMPs can be categorized into three categories, highly effective, marginally effective, and ineffective, depending on their efficacies in the killing of the various periodontal pathogens and clearance of biofilm. **Conclusion**: These novel bifunctional peptides have the potential to deliver AMPs directly to implant surface. They have the potential to improve oral health by controlling oral dysgenesis, reducing peri-implant disease progression, and decreasing the cases of implant failures. This strategy could be the basis for next-generation therapeutics and will have a significant impact on public health.

Poster #63

Title: IKKβ and TBK1 negatively regulate the CAD-mediated metabolic reprogramming

Authors: Chi Liang, Hansong Xia, Anjie Lu, Jun Zhao, Ting-Yu Wang, & Pinghui Feng

Faculty advisor: Pinghui Feng

Background: Cellular immune response is a metabolically

demanding biological process. The IkB kinase (IKK) ² and the IKK-related kinases TBK1 have essential roles in innate immunity through activation of NF-kB and interferon regulatory factors (IRFs). Carbamoyl-phosphate synthetase 2, aspartate transcarbamoylase, dihydroorotatase (CAD) deamidates the RelA subunit of NF-ºB in cancer cells to promote aerobic glycolysis and fuel cell proliferation in tumorigenesis. CAD catalyzes the rate-limiting step of the de novo pyrimidine synthesis, raising the possibility that metabolism can downregulate innate immune response. **Purpose**: The goal of this study is to test whether innate immune response can regulate metabolism, specifically whether innate immune kinases can phosphorylate and modulate metabolic enzymes. **Methods**: Protein interaction and kinase phosphorylation were defined by biochemical assays, including co-immunoprecipitation, in vitro kinase, tandem mass spectrometry analysis and mutation analysis. Innate immune response was characterized by real-time PCR and ELISA, whereas metabolism was defined by metabolite profiling with liquid-chromatography coupled with mass spectrometry. **Results**: Biochemical assays demonstrate that IKKβ and TBK1 interact with and directly phosphorylate CAD. Mass spectrometry analysis identified S147, S1827 and S1828 of CAD as the phosphorylation sites by IKKβ and TBK1. IKKβ- and TBK1-mediated CAD phosphorylation inhibits the de novo pyrimidine synthesis and metabolic reprogramming, aerobic glycolysis installed by deamidated RelA. With knockout cell lines, we showed that innate immune activation, relayed by activated IKKβ and TBK1, suppresses cellular metabolism, thereby restricting viral replication. Furthermore, phosphorylation-resistant CAD renders cells more refractory to suppression imposed by innate immune activation. Current experiments are assessing the metabolic enzymes that are regulated by IKKβ and TBK1 via phosphorylation. **Conclusion**: Our findings place metabolic pathways downstream innate immune defense, thereby forging a molecular link between cellular metabolism and innate immune defense.

DENTISTRY & CCMB AFFILIATES

Poster #64

Title: A review of elder abuse curriculum in US dental education

Authors: Nechama Citrin, Reyes Enciso, & Roseann Mulligan

Faculty advisors: Reyes Enciso & Roseann Mulligan

Background: Elder abuse is an evolving public health concern. Elder abuse is defined as actions or inaction by a caregiver or trusted individual that **results** in harm to a person aged 65 years or older. As mandated reporters of elder abuse in many states, dental providers require training in identifying, reporting and managing suspected cases. **Purpose**: This review aims to identify elder abuse curriculum models found in the literature, compare and contrast reported approaches and suggest interventions for future education. **Methods**: An electronic search in PubMed, EMBASE, Web of Science and Cochrane was performed on 9/30/2020 to identify studies pertaining to elder abuse education/training found in DDS and Dental Hygiene (DH) programs and continuing education for practicing dentists. **Results**: 199 records were retrieved and analyzed by one author. Of those, 22 studies on dental curricula and 10 editorials on the subject were gathered. Published curricula included mailed or in-person surveys as well as in-person or on-line didactic session(s) with pre- and post-session assessments. Survey results indicate that DDS/DH students as well as practicing dentists have limited knowledge and confidence in reporting elder abuse. Five reviews found that training programs are instrumental in increasing dental providers' knowledge and confidence in recognizing and reporting suspected cases of elder abuse in their patient encounters. **Conclusion**: Dental education on elder abuse needs to ensure that the curriculum provides future and current dental practitioners adequate training in identifying, reporting and managing suspected cases.

Poster #65

Title: COVID-19 pandemic "Safer at Home" community oral health activities

Authors: Kristine D. Parungao & Roseann Mulligan

Faculty advisor: Roseann Mulligan

Background: The Herman Ostrow School of Dentistry of University of Southern California (USC) in partnership with the California State of Los Angeles began a community oral health promotion program in 2017 to address the oral health of children, youth and young adults (ages 0 to 20). **Purpose**: The program was based on physical field outreach activities until the middle of March 2021 when the COVID-19 pandemic hit Los Angeles County and the rest of the world. The program transformed its physical outreach activities to a virtual model that continues to align with program goals. Method: The program developed "Safer at Home" activities which included virtual oral health presentations, development of oral health materials involving dental, dental hygiene and social work students, distribution of oral hygiene kits and telehealth consultations. **Results**: The program resulted in servicing 62 community sites, providing 1815 non-oral health community members with virtual oral health education, developing 14 oral health education presentations or videos, involving 22 dental and dental hygiene students, distributing 10,104 oral hygiene kits, and conducting 697 telehealth sessions. **Conclusion**: Community oral health programs are able to shift physical outreach activities to address oral health of the community that continues to align with program goals, while providing community oral health experiences to students and addressing oral health needs of families.

Poster #66

Title: DMFT index of people experiencing homelessness compared to national databases

Authors: Andia Ezzati, Reneih Abdelhafez, & Azita Ezzati

Faculty advisor: Mehdi Mohammadi

Background: Decayed, Missing, and Filled Teeth (DMFT) index is one of the most used epidemiologic indices in dentistry. People experiencing homelessness face significant oral health challenges besides other chronic conditions; according to recent studies, they suffer from poor oral health than the general population. **Purpose**: This study compares the DMFT score of patients seeking dental care at the USC dental clinics in the Skid Row area in downtown Los Angeles with national databases. **Methods**: This retrospective study is being conducted from existing patient records. The number of decayed, missing, and filled teeth are being extracted from each patient's dental record including X-rays and DMFT scores are calculated using an Excel sheet. As part of the project, the DMFT scores will be compared in different categories based on age, gender,race and ethnicity **Results**: Previous studies showed that the DMFT scores of people without housing were higher than the DMFT scores of the general population. We anticipate obtaining a significantly higher DMFT score among the underserved population of Skid Row compared to the general population.

Poster #67

Title: FaceBase3: Craniofacial

Development and Dysmorphology Data Management and Integration Hub

Authors: Thach-Vu Ho, Bridget Samuels, Yuan Yuan, Carl Kesselman, Robert Schuler, Alejandro Bugacov, Cristina Williams, & Yang Chai

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 FaceBase3 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 FaceBase2 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 950 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 #68

Title: Impact of the COVID-19 pandemic on health and health behaviors

Authors: Khola Ahmed Khan & Chuong Thien Tran

Faculty advisors: Joyce Sumi & Mariela Padilla

Background: New regulations were enforced during the COVID-19 pandemic to limit exposure and spread of the Coronavirus. Physical distancing strategies resulted in long-term home confinement and isolation for the majority population. A resultant of these measures impacted the behaviors affecting mental and physical health. **Purpose**: To provide an insight about how the COVID-19 pandemic affected mental and physical health behaviors. **Methods**: A topical literature search of published articles in Pubmed using keywords of COVID-19 and lifestyle changes dated from the initial pandemic lockdown of March 2020 to March 2021. Thirteen articles were hand-selected individually by the authors as appropriate in addressing the focused topic. Physical and mental health behaviors from the publications were extracted and categorized by domains. **Results**: The physical health behaviors related with COVID-19 were more frequent noting decreased hygiene habits, lack of motivation for physical activity, and nutritional changes. The mental health behaviors included increased stress levels, isolation and sleeping patterns. **Conclusion**: Identifying and understanding the pandemic impact on mental and physical health can guide the design of strategies to improve health behaviors. Findings indicate promotion of physical activities should have strong consideration. Further review of the topic is suggested.

Poster #69

Title: Pharmacological exposure interplays with *Twist1* mutations in exacerbating craniosynostosis

Authors: Eloise Stanton, Yuan Yuan, & Yang Chai

Faculty advisor: Yang Chai

Background: Craniosynostosis, the premature closure of calvarial sutures, leads to debilitating neurologic dysfunction through increased intracranial pressure. *TWIST1* mutation leads to Saethre-Chotzen syndrome, characterized by unilateral or bilateral coronal synostosis. A recent study showed that *in utero* exposure to a serotonin selective reuptake inhibitor, citalopram, increases the incidence of craniosynostosis in mice coupled with depletion of Gli1+ mesenchymal stem cells (MSCs), suggesting environmental risk factors interplay with genetic mutations in craniosynostosis etiology. **Purpose**: We would like to determine how Twist1 interacts with maternal usage of citalopram to disrupt cranial suture MSCs, leading to craniosynostosis. **Methods**: Cohorts of mice with or without *in utero* citalopram exposure (20 mg/kg/day) were generated, including (1) wild-type (WT) (n=14), (2) *Twist1*$^{+/-}$ (n=150), (3) WT/citalopram (n=9), and (4) *Twist1*$^{+/-}$/citalopram (n=13). MicroCT analysis was performed on postnatal day (P)14 to examine the extent of calvarial suture fusion, since the coronal suture typically completes fusion from P9-13 in *Twist1*$^{+/-}$ mice. **Results**: In utero exposure to citalopram in *Twist1*$^{+/-}$ mice led to increased aberrant suture fusion. No WT mice exhibited cranial suture fusion. Untreated *Twist1*$^{+/-}$ mice had 70-80% suture fusion penetrance. WT/citalopram group showed 22.2% suture fusion. Importantly, *Twist1*$^{+/-}$ mice with in utero exposure to citalopram had the highest rate of suture fusion, 92%. **Conclusion**: Citalopram exposure in utero leads to an increased frequency of craniosynostosis both in WT and *Twist1*$^{+/-}$mice. Our preliminary data suggest a combinatorial effect of genetic mutations and environment in the development of craniosynostosis.

Poster #70

Title: Center for Dental, Oral & Craniofacial Tissue & Organ Regeneration (C-DOCTOR)

Author: Bridget Samuels on behalf of the C-DOCTOR Consortium

Faculty advisor: Yang Chai

Background: The Center for Dental, Oral, & Craniofacial Tissue & Organ Regeneration (C-DOCTOR) is a public-private consortium focused on accelerating promising tissue engineering/regenerative medicine therapies for dental, oral, and craniofacial (DOC) tissue and organ regeneration to human clinical trials. **Purpose**: Our overall vision for C-DOCTOR is to be a comprehensive national resource center for the clinical translation of innovative regenerative technologies to replace DOC tissues or organs lost to congenital disorders, traumatic injuries, diseases, and medical procedures. **Methods**: We have recruited interdisciplinary teams with promising DOC regeneration therapies and developed the comprehensive, customized infrastructure through which we provide these teams the necessary clinical, scientific, technical, regulatory, financial, business-oriented, and managerial resources to facilitate their IND/IDE-enabling activities. **Results**: We direct the Center's resources to advance technologies that optimally align with unmet clinical needs, market potential, anticipated patient value, and high probability of clinical adoption. We will continue to provide teams with fully customized support from expert scientists, clinicians, commercialization strategists and regulatory advisors as the teams refine their products, complete their IND/IDE-enabling preclinical

studies, transition to current good laboratory/manufacturing practices for scale-up, develop clinical study protocols, form strategic partnerships, and interact with the FDA ahead of Phase I clinical trials. **Conclusion**: C-DOCTOR is accelerating the development of DOC regenerative medicine and can serve as a model for resource centers with similar goals.

Poster #71

Title: Effect of occlusal veneers thickness of endodontically treated molars

Authors: Mayara dos Santos Noronha, Camila Heitor Campos, Ahn Quynh Do, Marco Aurélio de Carvalho, Marcelo Giannini, & Pascal Magne

Faculty advisor: Pascal Magne

Occlusal veneer (OV) restorations can be indicated to restore endodontically-treated teeth (ETT) without removing unnecessary dental tissue. Their resistance may be affected by the type of the material and thickness. This study aimed to evaluate the influence of thickness and type of CAD/CAM material on fatigue behavior and failure mode of ETT restored with OV. Seventy-five (N=75) ETT were used. After the endodontic treatment, teeth were restored with Herculite XRV. For the control group, no occlusal veneers were added. Experimental groups with two different occlusal reductions (thin 0.6-0.7 mm and thick 1.4-1.6 mm) were restored with two materials (zirconia-reinforced lithium-silicate LS/Celtra Duo; and composite resin C/Cerasmart), resulting in 5 groups (n=15). After thermo-modified adhesive luting, the restorations were submitted to cyclic fatigue at a frequency of 5Hz, with a load starting at 200 N until 1800 N. The Kaplan Meier survival analysis was applied to the number of cycles data with a 95% level of significance (log rank test for post-hoc pairwise comparisons). No differences were found between thicknesses of the same CAD/CAM material ($p>0.001$). Thick Celtra occlusal veneers survived better than both Cerasmart groups and the control group ($p<0.05$). Failure modes were different with thin Cerasmart veneers and the control showing the highest percentage of reparable failures (40% and 46% respectively). In **conclusion**, a larger thickness of the same material did not improve its resistance. Thick Celtra duo showed best fatigue survival rate. The simple direct composite restoration yielded the highest rate of reparable failure.

OCCUPATIONAL SCIENCE & OCCUPATIONAL THERAPY FACULTY

Poster #72

Title: Investigating developmental norms of infants and children in rural Armenia

Authors: Allison Q. Phillips & 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.

OCCUPATIONAL SCIENCE & OCCUPATIONAL THERAPY DOCTORAL STUDENTS

Poster #73

Title: "Will you be okay?": empathy and grief experiences

Authors: David Turnbull, Elisa Apra, Linah AlShalaan, Zack Pinto, Patrick Harding, & Mary C. Lawlor

Faculty advisor: Mary C. Lawlor

There have been many misunderstandings and misconceptions about the social and emotional capacities of people with ASD. Although there has been some recent attention to grief and empathy, many descriptions of ASD populations in research and educational literature convey a constrained, deficit driven, and inadequate portrayal of sociality and emotional capacities. The purpose of this paper is to provide research findings across three studies that challenge current portrayals and generate insights related to a reconceptualization of our understandings of social and emotional connectedness for autistic people. We will draw on a series of ethnographic and narrative phenomenological studies with children and adolescents and young adults (AYA) with ASD and their families to present findings that counter prevailing assumptions and provide a more enriched depiction of expressions of grief and empathy in this population. These studies include: Autism in Urban Context: Linking Heterogeneity with Health and Service Disparities, NIMH, NIH, (# R01 MH089474); Adult Collective Narratives; and Community Engagement. Data collected from clinicians will only be incorporated as it helps to situate the primary data from people with ASD and their families. Findings include how: 1) grief experiences comingle amongst family members; 2) children and AYA with ASD demonstrate empathy through actions and social communication; 3) parental understandings of social and emotional capacities are transformed; 4) grief experiences are layered over time and across developmental periods; and 5) grief and empathy interrelate. Findings will be contextualized within a discussion of contemporary theories of empathy, intersubjectivity, and belonging.

Poster #74

Title: A timeline for tendon healing post-surgical repair using sonographic biomarkers

Authors: Sandy C. Takata & Shawn C. Roll

Faculty advisor: Shawn C. Roll

Background: Each year, over 100,000 people experience a traumatic hand tendon injury that typically takes several months to fully heal. 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 in real-time, ensuring a successful, efficient recovery. **Purpose**: To develop a timeline for tendon healing after surgical repair that can be monitored using sonography. **Methods**: An extensive literature review was conducted in PubMed and CINAHL around three main areas: 1) The tendon healing process, 2) sonographic biomarkers associated with tendon injury, healing, and recovery, and 3) the sensitivity and reliability of these biomarkers for tendons. **Results**: We developed a detailed timeline of the tendon healing process that includes: 1) The initial phase of healing immediately after surgery, 2) The intermediate phase of healing when outpatient rehabilitation is typically received, and 3) The long-term phase of healing that occurs several months after surgery. During the healing and recovery process, six sonographic biomarkers were identified: echogenicity, edema, hypervascularization; tendon excursion, thinning, and gapping. Furthermore, most of these biomarkers were reliable and sensitive to change. **Conclusion**: Using this information, we can begin to establish a reliable and sensitive sonographic protocol to evaluate post-surgical tendon healing with precision and across time. We hope that our research can help support clinical decision-making to individualize care, thereby optimizing outcomes for this population.

Poster #75

Title: Adaptating an ongoing clinical trial amidst the COVID-19 pandemic

Authors: Stacey Schepens Niemiec, Rafael Wagas, Jeanine Blanchard, Matthew Niemiec, & Alana Schoenhals

Faculty advisor: Stacy Schepens Niemiec

Background: The COVID-19 pandemic has disrupted ongoing clinical trials, requiring rapid changes to study protocols. **Purpose**: 1) Describe dynamic adaptations made to resume an RCT of a physical activity app intervention, Moving Up (MU), for older adults during COVID-19; 2) Describe study participation following adaptations. **Methods**: The Moving Up Study is a Multiphase Optimization Strategy RCT of the MU app for underactive older adults. Original study methods comprised in-person group sessions at community venues for testing (questionnaires, walk test, activity monitor application) and orientation (app setup, didactic presentation, video tutorial). The study halted in-person activities following COVID mandates, and resumed after protocol changes, staff training, and administrative approvals. **Results**: Key adaptations facilitated project restart including: re-screening previously eligible individuals; administering eConsents and e-questionnaires via REDCap; mailing activity monitors with detailed instructions; conducting orientations via Zoom screen share and remote control features; and adding posttest questions on COVID-related activity changes and app relevance. The primary recruitment source pre-/post-COVID was emailing senior organization members. Enrollment grew post-COVID (47% vs 65%). Participants pre- vs post-COVID onset were slightly older (72.9±4.9 vs 69.9±10.8y) and more likely to be female (81% vs 64%). The proportion of Whites and Asians rose (49% vs 72%; 5% vs 20%); proportion of Blacks markedly decreased (46% vs 8%). **Conclusion**: The Moving Up study was successfully adapted for remote implementation as older adults completed electronic forms, managed activity monitors, and learned a smartphone app. Opportunities for more inclusive technology-based studies for older people should be explored.

Poster #76

Title: An exploration of therapist-patient relationships in hand therapy

Authors: Katherine J. Loomis, Mark E. Hardison, & Shawn C. Roll

Faculty advisor: Shawn C. Roll

Background: Recent physical rehabilitation and hand therapy literature has advocated for a more holistic and collaborative approach to treatment planning and patient care. Although patient factors and therapeutic approaches have been identified as crucial elements, the therapist-patient relationship itself has not been widely researched. **Purpose**: To explore the perspectives of therapists working at an outpatient hand therapy clinic with the goal of identifying factors within this relationship that impact the provision of holistic and collaborative services. Specifically, we examine the interaction between therapist and patient roles within the therapeutic and greater medical environment, including balances of power and barriers or facilitators to therapeutic engagement. **Methods**: Principles of grounded theory were used to analyze data gathered in 2016 through thirteen group interviews with four occupational therapists working in a hospital-based outpatient hand therapy clinic. **Results**: Analysis of this data is ongoing, and several themes have emerged thus far. The therapist-patient relationship is intimate and dynamic, extending beyond education and application of physical intervention. Surprisingly, power within this relationship seems to be more fluid than anticipated, often impacted by patient preference and personal contexts. Additionally, engagement in the therapeutic process is co-constructed through this relationship rather than being an isolated patient experience. Therapists' ability to navigate the flow of this relationship and the emotional states within seems to be crucial to facilitating adherence. **Conclusion**: Further investigation into the dynamic and complex elements of this relationship may better inform strategies aimed at promoting collaborative care and ultimately facilitating adherence and successful patient outcomes.

Poster #77

Title: Associations between child sensory reactivity patterns and caregiver responsiveness

Authors: Emily Campi, John Sideris, Alicia McConnell Hatch, Ashley Masuda, Elizabeth Crais, Linda R. Watson, & Grace T. Baranek

Faculty advisor: Grace T. Baranek

Background: Caregiver responsiveness (CR) predicts outcomes for children with and at elevated likelihood for autism spectrum disorder (ASD). Children's sensory and communicative behaviors influence CR. Caregivers talk less and use more play actions when children demonstrate sensory hyporeactivity and limited communication. There is limited research on CR to children's sensory reactivity (SR) cues and factors that influence that responsiveness. **Purpose**: Examine associations between infant SR and CR to SR cues. **Methods**: Participants were a community sample (n=63) of 11-16-month-olds (M=13 months; 63.5% elevated likelihood for ASD [EL-ASD]; 68% male; 87% White) and their caregivers (68% mothers; 70% with at least a college degree). SR patterns were measured via the Sensory Processing Assessment, a semi-structured observational tool. CR was measured with a behavioral rating scheme (1, unresponsive-7, highly responsive) during caregiver-child interaction in four daily routines. CR scores across all routines were averaged to compute a mean score. Hierarchical linear regression was performed to analyze the associations between SR and CR. **Results**: The EL-ASD group differed from controls on hyporeactivity, seeking, and CR ($p<.05$). Interactions between risk group and SR and differences in correlations across risk groups were non-significant. Hyporeactivity was negatively associated with CR. **Conclusion**: The association between hyporeactivity and CR may be due

to caregivers having difficulty noticing and responding to hyporeactivity, which presents more subtly than other SR patterns. The loss of association with hyporeactivity after the addition of seeking could be due to a shared effect of seeking behaviors and hyporeactivity on CR.

Poster #78

Title: Caregiver-reported oral health education needs for african-american children

Authors: Dominique H. Como, Lucía I. Floríndez, Leah I. Stein Duker, & Sharon A. Cermak

Faculty advisor: Sharon A. Cermak

Background: Children from medically underserved or minority populations, such as African-Americans, experience significant oral health disparities. Some healthcare providers have reported that African-American parents exhibit limited knowledge about oral health risk factors known to impact health outcomes, including required frequency of preventative visits and comprehensiveness of patient-provider communications. **Purpose**: To identify how African-American caregivers prefer to receive oral health information for their children. **Methods**: Data were part of a larger mixed-methods study to determine barriers and facilitators to oral care for African-American children. A culturally-tailored survey examining oral health-related knowledge, attitudes, and practices was completed electronically by African-American caregivers with children aged 4-14 years (n=104). **Results**: Nearly 70% of respondents reported previously trying to find information to improve their child's oral health; of these, the most frequent sources included: the internet (51.4%; n=37), dental practitioners (45.8%; n=33), friends/family (22.2%; n=16), and other health professionals (i.e., pediatricians) (12.5%; n=9). An overwhelming number of participants (87.5%; n=91) reported they would like to learn additional ways to improve their child's oral health, with online being the preferred method of delivery (65.3%; n=66). **Conclusions**: African-American caregivers report seeking additional opportunities to obtain knowledge to improve their child's oral health. Research shows that improved oral health literacy can lead to better outcomes, including improved oral health attitudes and behaviors. Thus, tailored oral health education programs provided online may be an opportunity to mitigate oral health disparities for African-American families.

Poster #79

Title: Dental care for children with down syndrome: multiple perspectives

Authors: Elizabeth Isralowitz, Marinthea Richter, Melissa Martinez, Leah Stein Duker, & Sharon Cermak

Faculty advisor: Sharon Cermak

Background: Despite state and national initiatives to promote care for children with special healthcare needs (CSHCN), significant disparities in dental care persist. For example, many parents of children with Down Syndrome (DS) report difficulty finding and accessing dental care for their child. **Purpose**: Examine barriers and supports for the provision of dental care, as reported by parents of children with DS and dentists treating children with DS. **Methods**: Focus groups or interviews of parents (n=11) and of dentists (n=9) treating children with DS were conducted to explore perceptions of oral care barriers and supports. Descriptive and thematic analysis, informed by grounded theory, was performed for each group. **Results**: Six overlapping themes emerged from the two groups: (1) characteristics of the dental team; (2) treatment barriers/facilitators related to child-specific qualities; (3) family and dentist flexibility; (4) the need for a positive, patient-centered environment; (5) dentists' CSHCN-specific experience and knowledge; and (6) outcomes of dental techniques. Despite the overlap in dentist and parent identified barriers and supports, perceptions also differed. Parents emphasized the role of other family members and difficulty accessing dental care. Dentists discussed their subjective experiences and the influence of the dental environment on treatment tolerance. **Conclusion**: Promoting hands-on-learning, mentorship, and communities of practice among general and pediatric dentists, is likely to expand treatment access and quality for CSHCNs. Parents were eager to participate in the dental team but cited a need for more education and for dentists with experience and knowledge to treat children with DS.

Poster #80

Title: Developing a method to measure strain in dental hygiene work

Authors: Yiyang Fang, Kryztopher D. Tung, & Shawn C. Roll

Faculty advisor: Shawn C. Roll

Background: There is no current method to easily measure physical strain to the hand in dental hygiene work. The Revised Strain Index (RSI) is a commonly used tool that may be useful to examine the risk of work-related injury of dental hygienists. **Purpose**: The purpose of this study is to modify the RSI to validly measure exposure risk in dental hygiene practitioners. **Methods**: We conducted 36 live and video observations of dental hygiene patient visits and obtained self-reported ratings of exertion during scaling tasks on a Borg CR-10 scale. Using Observer XT software, we identified patterns of scaling and validated the categories with a group of dental hygiene experts. Through an iterative process, we tested exertions and wrist postures to identify the RSI multipliers that were the most valid representation of physical strain. We have conducted a preliminary analysis of 5 videos to identify a Composite Strain Index (COSI) score for each video. **Results**: We identified 3 exertion categories for hand scaling as light, moderate, and heavy with average exertion ratings of 2.3, 3.2, and 4.2 on a Borg scale. Wrist angles were categorized as flexion (<0°), neutral (0°-30°), and extension (>30°). The final RSI modifiers for exertion and angles were, 3.0, 4.0, and 5.5, and 1.2, 1.0, and 1.1 respectively across categories in each. A preliminary average COSI score for dental scaling tasks is 7.8. **Conclusion**: We have developed a valid method for examining physical exposure in dental hygiene work, with preliminary analyses indicating moderate risk of injury.

Poster #81

Title: Developmental trajectories of infant looking capacities during maternal-infant co-occupation

Authors: Cristin M. Holland, John Sideris, Pat Levitt, Barbara L. Thompson, & Grace T. Baranek

Faculty advisor: Grace T. Baranek

Background: Infant looking capacities, which undergo rapid shifts in the first year, are important to social interactions, but limited research exists that considers longitudinal development of these capacities during co-occupations between caregivers and infants. **Purpose**: We aimed to a) model developmental trajectories of the amount of time infants' looked at their mother or objects the mothers were holding from 2 to 18 months of age and b) determine the extent maternal responsiveness at 2 months predicts development of looking. **Methods**: A community sample of 56 infant-mother dyads were recruited. Looking capacities of infants were behaviorally coded for duration and responsiveness of mothers was rated during two minutes of mother-infant play at 2, 6, 9, 12 and 18 months. Latent growth curve models obtained looking capacity trajecto-

ries and determined if these were predicted by maternal responsiveness at 2 months. **Results**: Person looking model indicated an intercept of 9.83 seconds ($p<0.01$) and a slope of -0.02 seconds ($p=0.52$). Object-looking model had an intercept of 86.25 seconds ($p<0.01$) and a slope of -1.46 seconds ($p<0.001$). Responsiveness trended toward prediction of person looking intercept ($b=1.18$, $p=0.08$), but was not associated with either slope (person or object) or object intercept. **Conclusion**: Person looking remains stable, while object looking decreases across 2 to 18 months. During co-occupation at 2 months, mothers with higher responsiveness had infants who looked at them more. Caregiver responsiveness should be considered when **aim**ing to promote infants' looking at caregivers during play in early infancy.

Poster #82

Title: End of life care and occupational therapy

Authors: Nina Wakayama, & Stacey Schepens Niemiec

Faculty advisor: Stacey Schepens Niemiec

Background: Although occupational therapy services are available in end of life care, these services are often underutilized. **Purpose**: The purpose of this review was to explore the needs of patients receiving end of life care, as well as the role of occupational therapy in meeting patients' needs in this context. **Methods**: A literature review of peer-reviewed journal articles was conducted using PubMed and Google Scholar and by hand-searching reference lists from January 18, 2021 to March 26, 2021. Sample search terms included "needs," "role," and "end of life." **Results**: Twelve studies, publication dates ranging from 2000 to 2020, were identified as relevant. At the end of life, people's greatest needs fell into two primary categories: emotional and relational. They needed to cope with feelings of uncertainty and fear, and as their illnesses progressed, they were unable to continue fulfilling their roles as they always had. Occupational therapy's main role was to facilitate quality of life through occupational engagement, focusing on participation rather than performance. **Conclusion**: Understanding the unique needs of patients who are dying will allow occupational therapists to provide better client-centered care. Clearly defining occupational therapy's role may encourage greater interest in this practice area and may contribute to improved advocacy for the profession in end of life care.

Poster #83

Title: Evaluating parent experiences with research using remote child assessments

Authors: Daniela R. Valle, Allison Q. Phillips, & Grace T. Baranek

Faculty advisor: Grace T. Baranek

Background: Telehealth programs were created and experimented with in response to the pandemic (Taddei & Bulgheroni, 2020), and remote methods of assessments show preliminary feasibility (Talbott et al., 2019). Research, such as our lab's Longitudinal Study of Development of Social Communication and Sensory Regulation in Infants and Toddlers (SASI) adapted the original in-person study protocol and processes to a telehealth format in order to comply with COVID-19 restrictions. The remote format increased the expectations and demands of caregivers compared to that of the in-person version, where researchers conducted child assessments. **Purpose**: The purpose of this investigation was to develop a Parent Feedback Survey to collect data about caregiver experiences with the remote format of SASI and to inform quality improvement to better serve families during the research experience. **Methods**: The Parent Feedback Survey is a brief, 5-minute survey with 4 closed-ended questions, 6 open-ended questions, and 13 statements on a 5-point Likert scale. Content includes parent coaching, information distribution, and overall experience. These domains capture the caregiver perspective regarding study processes, acceptability and feasibility. **Results**: Descriptive statistics and qualitative themes will be presented. Preliminary data indicate caregivers strongly agreed that the examiner gave clear directions, somewhat agreed that emails were easy to follow, and endorsed an overall positive experience. **Conclusion**: The shift to remote assessments in the research context has been feasible. Understanding caregiver experience for quality improvement can inform processes of future studies that utilize telehealth approaches for child assessment.

Poster #84

Title: Extracurricular activity impacts dental hygiene and occupational therapy students' health

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

Faculty advisor: Shawn C. Roll

Background: Participation in certain extracurricular activities can help college students adjust to university life; however, the impact of participation in extracurricular activities on health after this initial transition remains unknown. **Purpose**: To model extracurricular activity participation relative to physical and mental health among dental hygiene (DH) and occupational therapy (OT) students. **Methods**: Data was collected from 85 DH students and 51 OT students at the beginning of their program and at the end of the first and second academic years. Students reported the total hours of participation over the past six months across 62 activities within eight categories. Physical and mental health was measured by SF-36, as a Physical Component Summary (PCS) and Mental Component Summary (MCS). Mixed-effect models were used to adjust the clustering of data. **Results**: Among all students, PCS remained the same across time while MCS significantly decreased ($p<0.05$). Within the DH students, PCS increased over time, and MCS decreased (both $p<0.01$), while PCS and MCS remained similar across time in the OT students. Among both groups, the average time spent in sports, fitness, social, and work/volunteer activities decreased across time ($p<0.05$). DH students participated in fewer social activities than OT students ($p<0.001$). Starting to participate in work/volunteer activities was associated with a decrease in PCS and an increase in MCS (both $p<0.05$). **Conclusion**: The deterioration of mental health in DHS along their academic years warrants attention. Engaging in work/volunteer activities improved students' mental health though impeded physical health.

Poster #85

Title: Feasibility of psychophysiological measure of parental stress in the NICU

Authors: Marinthea Richter, Leah Stein Duker, Jenny Kwon, & Bobbi Pineda

Faculty advisor: Bobbi Pineda

Background: Preterm birth and admission to a neonatal intensive care unit (NICU) has been linked to parental stress, which impacts parent-infant interaction and parental roles. Electrodermal activity (EDA) is a non-invasive measure of activation of the sympathetic "fight or flight" nervous system, which increases due to stress. EDA has not previously been used to understand the stress parents experience when interacting with their infants in the NICU. **Purpose**: To examine the acceptability and feasibility of using wearable sensors to describe the stress of parents in the NICU while providing sensory experiences to their infants. **Methods**: A prospective observational study with seventeen parent-infant dyads (born <32 weeks gestation) took place in a level IV NICU.

Parents wore the wireless Empatica E4 wristband to record psychophysiological stress before, during and after engaging in a 10-minute sensory experience with their infant. **Results**: All parents reported the use of wireless sensors to be acceptable in the NICU environment while engaging with their infants; of the collected EDA, 12 recordings (71%) were usable. Three distinct patterns of EDA responses were identified: (1) temporary increase at beginning of intervention, followed by a decrease or plateau; (2) gradual rise throughout intervention, or (3) plateau from baseline to intervention. Additionally, data evidenced a clear psychophysiological response to possibly stressful encounters, with 82% of parents experiencing a stressful disruption during the parent-infant interaction. **Conclusion**: The use of wearable EDA sensors during parent-infant sensory interaction is feasible in the NICU.

Poster #86

Title: Function and emotion in everyday life with type 1 diabetes

Authors: Loree Pham, Raymond Hernandez, Khatira Mehdiyeva, & Elizabeth Pyatak

Faculty advisor: Elizabeth Pyatak

Background: While short-term blood glucose (BG) levels and variability are thought to underlie diminished function and emotional well-being in people with T1D, these relationships are poorly understood. The Function and Emotion in Everyday Life with T1D (FEEL-T1D) study focuses on investigating these short-term dynamic relationships among BG, function, and emotional well-being in adults with T1D. The COVID-19 pandemic forced reconfiguration of the FEEL-T1D protocol to be fully remote. **Purpose**: To present the FEEL-T1D study design, methods, and study progress to date, including adaptations necessitated by the COVID-19 pandemic. **Methods**: Adults 18-75 with T1D complete a comprehensive survey battery, along with 14 days of intensive longitudinal data collection using blinded continuous glucose monitoring (CGM), ecological momentary assessment (EMA) surveys and cognitive tasks, and accelerometers. All study procedures are conducted remotely. **Results**: To date, 94 participants have enrolled in the FEEL-T1D study. Nearly 80% have provided concurrent CGM, EMA, and accelerometer data for at least 10 of the 14 days of data collection, and nearly 90% of EMA surveys have been completed, with minimal missing data. **Conclusion**: Overall, our reconfiguration of the FEEL-T1D protocol to be fully remote has been a success. Without transitioning to remote procedures, conducting the study during the COVID-19 era would not have been possible. Even when in-person research becomes possible, there are several advantages to continuing remote study procedures including the ability to reach participants over a wider geographical area and greater ease of scheduling digital appointments relative to in-person ones.

Poster #87

Title: Healthcare toolkit to improve women's healthcare utilization for autistic women

Authors: Shona Maher, Helen Tran, & Amber Angell

Faculty advisor: Amber Angell

Background: Autistic females are identified as an understudied, underserved group. Autistic women may face disparities in women's healthcare access and utilization compared to the general population. This is particularly alarming because autistic women may be at increased risk for numerous women's health conditions, including ovarian and breast cancer, and sexually transmitted infections (STIs). The Academic Autism Spectrum Partnership in Research and Education (AASPIRE) created an evidence-based healthcare toolkit to improve primary care navigation for autistic adults. The toolkit has strong content validity, improves healthcare self-efficacy, and decreases patient reported barriers. **Purpose**: The purpose of this research study is to adapt the AASPIRE toolkit for women's healthcare access/utilization and implement it at Rancho Los Amigos National Rehabilitation Center. **Methods**: (1) We will compare frequency of women's cancer screenings and STI testing among autistic patients vs. national recommendations, using electronic health record data. (2) We will conduct qualitative interviews with autistic women to identify barriers and facilitators to women's healthcare access. (3) We will collaborate with autistic and healthcare provider stakeholders to adapt the AASPIRE Healthcare Toolkit for women's healthcare navigation. (4) We will pilot test the toolkit at Rancho, measuring implementation outcomes of acceptability, adoption, and sustainability. **Results**: N/A (We are starting phases 1-2 using current funding and will then seek funding for phases 3-4.) **Conclusion**: By adapting and implementing an evidence-based healthcare toolkit, this project will improve women's healthcare access and utilization, and thus health outcomes, for autistic women.

Poster #88

Title: Interdisciplinary training to reliably code intentional communication in caregiver-child interactions

Authors: Elizabeth Choi, Cristin Holland, Elizabeth M. Phelps, Chloe Rey-Talley, Stephen Morrison, Linda R. Watson, & Grace T. Baranek

Faculty advisor: Grace T. Baranek

Background: Interdisciplinary research promotes integrating knowledge across domains, enhancing the study of complex phenomena. For example, examining infants' communication skills (an area of focus in speech-language pathology) can provide additional insight into the study of caregiver-infant engagement in daily routines (an area of focus in occupational therapy). Such cross-training can push occupational therapy students beyond their comfort zones and expand their perspectives as they rarely receive formal training in this domain. **Purpose**: We present the process of training occupational therapy students to reliably code infants' intentional communication. **Methods**: Students coded behaviors from video recordings of caregiver-child interactions during play, snack, and clean-up activities. They were considered ready to code independently after reaching ≥ .70 inter-observer agreement (IA) with master codes by a speech-language pathologist. Coders met weekly to discuss coding disagreements and questions. **Results**: Initial IA across five weeks was low (M=.55). Feedback at this stage aimed to solidify understanding of intentionality (i.e., evidence of directedness towards caregivers) and clarify coding criteria. Re-coding led to improved IA (M=.66). In the second training phase lasting three weeks (IA M=.64), feedback emphasized coding conservatively (e.g., requiring strong evidence of directedness) and confirming each code with the manual. Re-coding led to greatly improved IA (M=.75). IA ≥ .70 on codes before feedback was then achieved across two consecutive weeks. **Conclusion**: Coders reported a newfound understanding of ways infants communicate as well as how intentionality can be determined even in young infants, supporting a broadened, interdisciplinary view of how infants engage with their caregivers.

Poster #89

Title: Considering clinical global impressions for pediatric occupational therapy

Authors: Elizabeth M. Phelps, Emily Sopkin, & Grace T. Baranek

Faculty advisor: Grace T. Baranek

Background: Clinical Global Impressions (CGI) is a 2-item scale developed in psychiatry that efficiently captures clinician impressions of symptom sever-

ity and degree of improvement. Given its brevity and sensitivity to change, a CGI scale could be useful in occupational therapy (OT) practice and research, but currently none are used. **Purpose**: To understand the development and use of CGI scales, and to draw conclusions about possible applications in pediatric OT for assessing sensory processing. **Methods**: A preliminary literature search was conducted in PubMed and Google Scholar using the following search terms: pediatrics, clinical global impression, development or creation, benefits or support, use or implementation or adoption, and/or history. To date, we reviewed 11 publications; target is 20. **Results**: We found that CGI scales were used in a variety of settings with diverse populations. Several diagnosis-specific CGIs (i.e. CGI-Angelman Syndrome) were developed. Intervention studies often used Severity scores as inclusion criteria, and Improvement scores as outcome measures. In practice, diagnosis-specific scales offer clinical presentation descriptions for assigning CGI ratings. These scaffolded clinical reasoning and guided clinicians to consider multiple domains of the client's condition to inform an overall judgement of symptom severity. **Conclusion**: Its versatility and ease of use indicate the CGI would be a good fit for OT clinical and research settings. Current pediatric assessments for sensory processing are time-consuming and rely heavily on parent-report. A CGI scale specific to sensory processing could be used to comprehensively yet concisely document gestalt client performance at both evaluation and throughout intervention.

Poster #90

Title: Occupational balance of college students during a pandemic

Authors: Nikki T. Nguyen, Maggie Young, Valerie Tapia, Kelly Deng, Elizabeth Isralowitz, Dominique H. Como, Melissa Martinez, & Sharon A. Cermak

Faculty advisor: Sharon A. Cermak

Background: The COVID-19 pandemic has caused abrupt changes in the lives of many. One specific group who has experienced many changes is college students, as a result of disrupted living environments, limited social supports, and shifts in educational experiences. These types of changes of pattern in daily occupations and occupational balance have been shown to be closely related to both physical and emotional well-being (Wagman & Hakansson, 2014). **Purpose**: This study examines the relationship between college students' occupational balance and satisfaction with participation in activities during the COVID-19 pandemic, and the effects on perceived psychological well-being as manifested by depression, anxiety, fatigue, and stress. **Methods**: Participants were 152 undergraduates (37 male, 109 female, 4 non-binary, 1 transgender, 1 gender-fluid), ages 18-25, who were recruited through social media and Research Match, registry. Participants completed an online survey about their well-being during COVID-19. Instruments included the Occupational Balance Questionnaire-11 (OBQ-11), General Anxiety Disorder (GAD-7), PROMIS Depression Short-Form-6a, Perceived Stress Scale-10 (PSS-10), and PROMIS Fatigue Short-Form-6a. Occupational balance and self-ratings of psychological well-being were examined using Spearman's rank correlation. **Results**: The OBQ-11 ($p<.01$) and measures of perceived psychological well-being were significantly correlated ($p<.01$). Time use and activity participation satisfaction are strongly associated with less anxiety, $r=-.465$; depression, $r=-.465$; stress, $r= -.525$, and fatigue, $r=-.529$. **Conclusion**: This study demonstrates that occupational balance and participation during COVID-19 may protect against negative psychological health outcomes and may be a successful way to treat symptoms of anxiety and depression.

Poster #91

Title: Occupational science in occupational therapy practice: an exploratory qualitative study

Authors: Nicole Yoon, & Tessa Milman

Faculty advisor: Tessa Milman

With occupational science being acknowledged as providing the "essential foundations of occupational curricula", it has been established that a focus on occupational science has provided a more theoretical and innovative understanding to occupational therapy practice (WFOT, 2012). In her editorial letter, Dr. Laliberte Rudman (2015) discusses how occupational science and occupational therapy can intersect and inform each other to "advance knowledge and practice relevant to occupation, participation, and health". This intersectionality provides a richer understanding of occupation, helps occupational therapists understand people's subjective experiences, and addresses population, participation, and health needs at an individual and societal level furthering the reach of occupational therapy (WFOT, 2012). Using a narrative inquiry methodology, we aim to interview occupational therapists to explore how they have used occupational science in their practice. We would like to understand how it contributes, if at all, to their clinical reasoning and connection with clients in practice and through the analysis, identify recurring occupational science concepts surrounding their experiences. We hope that the preliminary analysis will yield the impact, if any, a background in occupational science has had on their overall roles as occupational therapists. The understanding and implications of these narrative experiences can acknowledge the growing value of occupational science theory to occupational therapy in order to support developments, both domestic and international, in education and in practice.

Poster #92

Title: Optimizing inclusivity and community participation for people with autism

Authors: Kelly Chang, Mariamme Ibrahim, Linah AlShalaan, Zack Pinto, Erna Blanche, Mary C. Lawlor, & Emily Ochi

Faculty advisors: Mary C. Lawlor & Emily Ochi

Despite increasing pressure to ensure that all Autistic people have opportunities to freely engage in communities and participate in desired activities, there continues to be a significant gap between current forms and extent of engagement and optimal engagement in inclusive communities. Although there are many interwoven contributors to this unacceptable gap, we believe the capacity of people and communities to flexibly provide developmental, learning, and social scaffolds to facilitate optimal experiences in natural environments, is a major and remediable impediment. Throughout the literature, researchers use inconsistent criteria to define community participation for autistic individuals (Simplican, Leader, Kosciulek, & Leahy, 2015). Notably, given the social nature of community settings, the construct of social engagement as a critical component to successful community participation for autistic individuals has been remarkedly undertheorized. Moreover, a limited understanding of the facilitators and barriers to community participation may contribute to the lack of literature related to the effective implementation of interventions designed to improve community participation outcomes for this population. This paper aims to expand the conceptualization of community participation for autistic individuals by drawing on several narrative phenomenological and ethnographic research studies to explore the varied forms in which autistic individuals participate in their communities. Data exemplars from research with autistic individuals, family members, and clinicians and providers will be provided. Examples highlight

the complexity and personalized nature of participation for this population while illustrating how experiences shape identity and social learning.

Poster #93

Title: OT's role in building a peer mentorship program through Disabilities Services & Programs

Authors: Nora Dixon & Bethrese Padini

Faculty advisor: Tracy Jalaba

Background: Student mentorship is common in colleges to promote student wellness, but there is limited research on a mentorship model in which both mentors and mentees are students with disabilities (SWD). The purpose of this poster is to propose a peer mentorship model for college students with disabilities in order to promote life balance and self-efficacy. **Methods**: We conducted a literature review to assess the needs of college students with disabilities and analyze best practices for mentorship models. Additionally, we interviewed four stakeholders--two representatives from Disabilities Services & Programs (DSP), one supervisor of a peer mentorship program, and one student registered with DSP. After conducting our literature analysis and stakeholder interviews, we created a proposal for a peer mentorship program called Balancing L.I.F.E (Learning, Independence, Friendship, Empowerment) to be housed through USC's DSP. **Results**: Through our research, we discovered the needs of college students with disabilities and the needs of a successful mentorship program. College students with disabilities reported higher needs of self-advocacy, adaptive skills, navigation of the DSP system, and emotional regulation. A successful mentorship program needs sufficient mentor training, appropriate mentor-mentee matching, consistency, and plans for sustainability. **Conclusions**: By utilizing the criteria for a successful mentorship program, it is our hope that the needs of college students with disabilities will be met. We proposed our mentorship program to DSP at USC and are planning to launch the program this Fall. Further research is needed to measure the effectiveness of the program once implemented.

Poster #94

Title: Profiles of early autism-related behavioral markers and associated age-3 outcomes

Authors: Yun-Ju Chen, John Sideris, Linda Watson, Elizabeth Crais, & Grace Baranek

Faculty advisor: Grace Baranek

Background: Autism spectrum disorder (ASD) is a complex condition that encompasses difficulties in social communication, sensory reactivity and motor coordination. Assessing the early risk manifestations in these domains is critical to parsing ASD heterogeneity. **Purpose**: This study aimed to identify homogeneous profiles based on the three domain scores of the First Years Inventory (FYI) – Social Communication (SC), Sensory-Regulatory Functions (SR), and Motor Development (MD), as well as their associations with age-3 outcomes. **Methods**: A community sample of 6,386 parents completed the FYI when their child aged 6-16 months, and 2,215 of them completed surveys about their child's developmental outcomes two years later. Latent profile analysis was performed to identify the FYI profiles. Demographics and age-3 outcomes were compared across the profiles with ANOVA and equivalence tests for odds ratios. **Results**: The best-fitting model was a four-profile solution. Profile-1 (84.5%) had the lowest risk levels across all domains. Profile-2 (10.8%) and Profile-3 (1.5%) scored high on SC and MD, while Profile-3 showed higher overall risk. Profile-4 (3.2%) scored particularly high on SR. Children in Profile-3 and 4 were more likely to have a later outcome of ASD or sensory processing disorder. **Conclusion**: These findings revealed heterogeneous manifestations of early ASD-related risk in a large community sample, with four subgroups differing in demographics and later developmental outcomes. These indicate the importance of dimensional assessments in parsing heterogeneity of early ASD risk profiles and the need for better tailored interventions.

Poster #95

Title: Supports for autistic adults: mothers' perspectives on insufficient services

Authors: David Turnbull, & Mary Lawlor

Faculty advisor: Mary Lawlor

Background: Health and quality of life outcomes for autistic adults have remained remarkably poor despite growth in research and service spending. Few services exist for autistic adults; those that do are often unaligned with priorities of the autistic community. **Purpose**: We sought to enhance the understanding of the lived experience of autistic adolescents and young adults (AYA). Barriers and facilitators to community engagement and participation were identified through a series of narrative phenomenological and ethnographic studies. **Methods**: Autistic individuals, family members, and clinicians participated in semi-structured narrative interviews and "Collective Narrative" group-based interviews on topics related to community. Data was transcribed verbatim and coded thematically. Triangulation of informants, methods, and researchers enhance rigor. Examples from interviews of parents of autistic AYA will be given to represent themes related to service availability. **Results**: Families in our sample were universally unsatisfied with services and support for autistic AYA. Parents expressed anxiety about the future and had little hope for current systems of care. When asked to think about a program that could support their child, parents would often start their answer with, "if I won the lottery," or "If God granted me a miracle." **Conclusion**: The experience of navigating our system of care has left the parents of autistic children with the impression that their odds of winning the lottery are better than of finding quality services or support in adulthood. Adequate services should not require a miracle. Scholars must do more to investigate and implement the support desired by autistic adults.

Poster #96

Title: The damaging effects of subjective categorizations on autistic individuals

Authors: Kelly Chang, Mary C. Lawlor, Emily Ochi, & David Turnbull

Faculty advisor: Mary C. Lawlor & Emily Ochi

Over time, categorizations have emerged in an effort to better understand individuals with autism; a task made more complex by the heterogeneity of autism. However, the subjective and restrictive nature of these terms, namely the subgroups of "high-functioning" and "low-functioning," can be detrimental to understanding autism. In research and media, "high-functioning" has been typically used to describe individuals with higher IQ; milder cognitive, social, and behavioral symptoms; and strengths in language, (Alvarez, et al., 2019). These characteristics do not necessarily correlate with long-term success (Magiati, et al., 2014). Therefore, the use of these simplistic terms can limit the resources and opportunities offered and be overall damaging to autistic individuals and lead to misunderstandings related to strengths and capacities as well as needed supports and scaffolds. Although there is a need and call to come up with better and more inclusive language to encompass all autistic individuals and their experiences, solutions have been elusive. We draw from narrative phenomenological and ethnographic data to identify themes that problematize the use of these categories. The collective narratives from parents and caregivers demonstrate that 1) categories

do not accurately reflect their children's abilities; 2) categories diminish opportunities for their children to engage in community and social participation; and 3) the subjective usage of "high-functioning" and "low-functioning" verbiage creates assumptions and hurtful stigmas which can be damaging to autistic individuals and their families. Possible alternative taxonomies are considered.

Poster #97

Title: Validation of a repeated measure of daily task load

Authors: Raymond Hernandez, & Elizabeth Pyatak

Faculty advisor: Elizabeth Pyatak

Background: Task load is the cost (e.g. fatigue, stress, illness) of performing tasks. The National Aeronautics and Space Administration Task Load Index (NASA-TLX) has been validated to measure task load of particular tasks and load of whole workdays. TLX-6 is the multidimensional full version of the TLX with all six items, while TLX-4 is an abbreviated version with four items found to load onto a single factor in a prior study. **Purpose**: Investigate the validity of TLX-6 and TLX-4 for measuring task load over a whole day in the repeated measures context. **Methods**: We analyzed data on 51 people with type 1 diabetes as part of a larger study collecting ecological momentary assessment and daily diary data over 14 days. The NASA-TLX was administered at the last survey of every day. **Results**: Confirmatory factor analysis fit metrics indicated that neither the TLX-6 or TLX-4 were unidimensional. In exploratory analyses, another set of TLX items we refer to as TLX-4v2 was found to be unidimensional. Raw sum scores from the TLX-6 and TLX-4v2 generally had plausible relationships with other measures as evidenced by within-person correlations and mixed modeling tests. **Conclusion**: We found evidence supporting the validity of the TLX-6 and TLX-4v2 in the whole day repeated measures context. TLX-6 appears to capture multiple factors contributing to task load, while TLX-4v2 assesses the single factor of "mental strain." The TLX may be particularly useful for investigating how daily task load covaries with day level well-being measures (e.g. headache severity, etc.)

Poster #98

Title: What's up dog? Friendships with furry friends through telehealth

Authors: Kellie C. Miyashima, & Shelby Surfas

Faculty advisor: Shelby Surfas

Background: Trauma leads to symptoms synonymous to ADHD such as inattention and impulsivity, or lead to an ADHD diagnosis. It can also lead to depressive symptoms, and anxious, defiant, and tantrum behaviors. Dogs help promote social interaction and increase comfortability and authenticity (Fine, 2015). Therapies including animals help reduce symptoms of mental illness (Koukourikos et al., 2019). Using dogs as part of sessions over telehealth help clients feel comfortable with answering questions about their needs/wants, and/or projecting those requirements onto the dog. **Purpose**: The goal was to create a telehealth protocol utilizing a practitioner's dog to decrease symptoms of ADHD and increase the ability to identify basic needs thereby assisting with emotional and behavioral regulation. **Methods**: The outcome measure utilized in this study combines questions from the Vanderbilt and Devereux Early Childhood Assessment. This will be a pre-post test study with outcomes analyzed at 0, 6, and 12 week marks. Qualitative data from parents and practitioners will also contribute. Each outcome is paired with its own question to the pediatric client about the dog and about themselves. **Results**: Qualitatively, other practitioners have reported improvements with identifying needs/wants. However, further research still needs to be conducted in order to generate quantitative results. **Conclusion**: There is some positive effect of using a pet over telehealth in order to "check-in" with a client at the beginning of a session.

Poster #99

Title: Work from home during COVID-19 as negotiating time and space

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

Faculty advisor: Shawn C. Roll

Background: COVID-19 led to major shifts in daily lives around the world. Many workers had to suddenly transition to working from home to follow social distancing measures. Work from home (WFH) offers many benefits, from saving operation costs to supporting worker wellness; however, when poorly managed, WFH can negatively impact worker health and quality of life. **Purpose**: We aimed to understand lived experiences of workers transitioning to WFH during COVID-19. **Methods**: A national survey was conducted and comments from two free-response questions regarding experiences of WFH (N=648, N=366) were analyzed using inductive qualitative content analysis. **Results**: Two primary themes, the temporal and spatial aspects of WFH, were framed by an overarching construct of intersections of work and home. The positive aspects of WFH, such as increased flexibility and autonomy, were juxtaposed with the challenge of setting boundaries between work and home life. Individuals' experiences of WFH were heavily influenced by the role demands of work and home, as well as the amount of environmental and organizational supports. While the context of a global pandemic was an added stressor, many individuals hoped to continue to WFH providing that supportive policies and resources were available. **Conclusion**: This study highlights how intersections of work and home affected WFH experiences and worker well-being. The widespread implementation of WFH will likely accelerate the pre-existing trend towards increase of WFH and other nontraditional work arrangements. There is a need to rethink worker needs in the WFH context to better support worker health and well-being.

Poster #100

Title: Balancing Everyday Life (BEL) versus occupational therapy in mental health populations

Authors: Skyler Lin, Mona Eklund, Carina Tjörnstrand, Mikael Sandlund, & Elisabeth Argentzell

Faculty advisor: Myka Winder

Mental health diagnoses often decrease quality of life and diminish meaningful occupations which affect health and mortality. No single intervention can address all symptoms, and while interventions like lifestyle redesign have been proven to be effective with other populations, there is significantly less literature on interventions focusing on daily lifestyle and/or improving quality of life. The Balancing Everyday Life (BEL) program was created for specialized and community-based psychiatric settings to address everyday life broadly and assist individuals with mental health diagnoses to obtain a good and stable way of life. The BEL program was administered over 16 weeks with one session a week at specialized and community-based programs. The BEL program could be administered to the adult population with any mental health diagnosis barring substance abuse, developmental disorders, and dementia to increase functional occupational participation. The study has indicated that the BEL program is time-effective in improving patient quality of life and functional engagement with meaningful occupations, indicating this

intervention could be beneficial in adult mental health settings when implemented alongside standard care. Further analysis, however, needs to be done on factors regarding care context to further strengthen the study's findings.

Poster #101

Title: Decolonization of occupational therapy: A Ghanaian perspective

Authors: Joana Nana Serwaa Akrofi, Stefanie Bodison, & Tessa Milman

Faculty advisors: Stefanie Bodison & Tessa Milman

Background: Decolonization is an emerging term in Occupational Science literature that has dominated several global discourses. Decolonialism is a political movement aimed at liberating ex-colonialized people (Dirette, 2018). Being relatively new in Ghana, one may say that occupational therapy is in its formative years, making Ghana a ripe target for the decolonization agenda. **Purpose**: The purpose of this study was to determine how western ideologies have influenced Ghanaian occupational therapy education and practice. **Methods**: A descriptive qualitative study was conducted. Semi-structured interviews were administered with four Ghanaian occupational therapists and thematic analysis was used to analyze the data. **Results**: Initial analyses of data indicated that because occupational therapy was made by westerners for westerners, its foundation is laced with western ideologies. However, Ghanaian occupational therapists reported that limited practical training during their education may have led them to individually contextualize westernized theories in their practice. Whilst Ghanaian therapists generally demonstrate occupational consciousness (Ramugondo, 2015), they lack sufficient power to effectively decolonize, and find that in their quest to decolonize, they have to rely on aid from the very westernizers who colonized them. **Conclusion**: Ghana, a former British colony, is still in many ways "colonized" with major disparities in access to power, knowledge and being (Dirette, 2018). Hence decolonizing occupational therapy in Ghana may be more challenging than in other places in the world despite the efforts of Ghanaian therapists to push back. In many ways, westerners still control the power dynamics in field of occupational therapy.

Poster #102

Title: Engagements of police and autistic people: strategies to optimize outcomes

Authors: Monica Caris, David Turnbull, Riley McGuire, & Mary C. Lawlor

Faculty advisor: Mary C. Lawlor

Autism Spectrum Disorder (ASD) is increasing in prevalence. Despite research showing that autistic individuals are more likely than their neurotypical peers to come in contact with the police, most police officers in the U.S. do not receive training on how to work with autistic people or identify behaviors that are commonly misinterpreted, such as running from police. Misinterpretation has led to an increased likelihood of harm. The purpose of this abstract is to synthesize literature to provide a greater understanding of autism, identify characteristics of police and autistic people's interactions, discuss an innovative training module, and provide an evaluation of this training approach. Research suggests that many police officers lack basic training, are unaware of the common characteristics of ASD, and feel underprepared for problem solving in the field. There are few recommendations on how and when to administer this training and what types of training are most effective given the complicated nature of policing. An innovative approach to preparing officers for more positive experiences in the field was incorporated by drawing on video encounters and inclusion of the autistic voice. Program feedback was analyzed to identify knowledge acquired, satisfaction, and potential for influencing future practices. We argue that officers should have a basic understanding of ASD and how to work with autistic people. Collaborations among professionals such as occupational therapists, the autistic community, and police has the potential to positively impact encounters between autistic persons and police officers.

Poster #103

Title: Participation in health promoting occupations for individuals with intellectual disability

Authors: Brittany St. John, Megan Gray, Amanda Malzacher, Libby Hladik, Savanna Lurie, & Karla Ausderau

Faculty advisor: Karla Ausderau

Background: Understanding the daily health experiences of people with intellectual disability is necessary to illuminate factors that may be influencing health and health disparities. **Purpose**: The objective of this study is to understand how people with intellectual disability participate in and access health promotion. **Methods**: Ten adults with intellectual disability engaged in an adapted photovoice study. **Results**: Four themes emerged: Health Is Who We Are; Health is What We Do; Health Is Our Body, Mind, and Place; and Barriers and Facilitators. Participants communicated an understanding of health, a strong identity of themselves as being healthy, and diverse participation in health promotion. Additionally, participants identified specific resources and support necessary to pursue health. Participants' broad description of health aligns with understandings of the social determinants of health. **Conclusion**: Participant's holistic view of health and experienced factors of health promotion should inform the development and implementation of inclusive health programming for people with an intellectual disability.

Poster #104

Title: Psychedelics and occupational therapy

Authors: Justin Telles, & Samia Rafeedie

Faculty advisor: Samia Rafeedie

Background: The value of psychedelic compounds as a treatment for psychiatric disorders is a rapidly developing field of study emerging from a backdrop of formerly restricted research. Although a resurgence of scientific studies is underway, their safety and efficacy as an effective therapeutic intervention continue to be determined in clinical trial research. Moreover, to date there has been no published research discussing the intersection of psychedelics with occupational therapy, and this synthesis represents a development of this relationship. **Purpose**: The present research synthesis aims to analyze this resurgence of scientific inquiry, interpret the various clinical conclusions, and discuss the potential practical implications for the field of occupational therapy. **Methods**: Systematic search of PubMed, USC Health Sciences Catalog, and USC Library for English language quantitative research studies on psychedelics published after 2010. **Results**: Seven research articles including 151 participants were selected based on their peer-reviewed design and study of psilocybin or lysergic acid diethylamide (LSD). **Conclusion**: This review synthesizes the results of seven clinical trials examining the therapeutic value of psychedelic substances and provides scientifically established support for their safety and efficacy as treatment for various psychiatric disorders. Additionally, given the immediate and enduring effects of these compounds on study participants, occupational

therapy practitioners may be uniquely suited to provide therapy preparation care, integration services, and other outpatient specialty treatment associated with the healing process.

OCCUPATIONAL SCIENCE & OCCUPATIONAL THERAPY AFFILIATES

Poster #105

Title: Oral care and sensory over-responsivity in children with Down syndrome

Authors: Melissa Martinez, Sharon Cermak, & Leah Stein Duker

Faculty advisor: Leah Stein Duker

Background: Sensory over-responsivity (SOR) has been linked to oral care challenges in multiple clinical populations. However, despite reports of both oral care and SOR in children with Down syndrome (DS), no literature has examined this relationship. **Purpose**: To investigate the association between SOR and oral care challenges in children with DS. **Methods**: Participants included 367 English-speaking parents of children with DS ages 5-14 throughout the U.S. who completed a 48-item online survey about oral care and sensory processing. Chi-square analyses tested for associations between sensory-related and oral care variables. **Results**: Based on cut-scores using responses by parents of typical children, parents who reported that their child experienced "moderate-to-extreme" over-sensitivity on three or more of eight sensory modalities were categorized as "sensory over-responders" (SORs; n=142); those reporting two or fewer were categorized as "sensory not-over responders" (SNOR; n=225). Overall, parents of children with DS in both sensory groups reported similar challenges with oral care experiences in the home and dental settings. However, some significant between-group differences were reported: more parents reported that their SOR child's behavioral difficulties and sensory sensitivities make dental appointments challenging, that their SOR child would be extremely afraid to go to the dentist and that their child disliked sensory-related stimuli at the dental office (e.g., lights, sounds); in the home, more SOR children required complete assistance for toothbrushing. **Conclusion**: Children with DS experience many challenges with oral care in the home and dental office environments; sensory processing challenges may play a role in some of these difficulties.

BIOKINESIOLOGY & PHYSICAL THERAPY PHD CANDIDATES

Poster #106

Title: Assessing contingency learning in infants at elevated risk of autism spectrum disorder

Authors: Marcelo R. Rosales, Nina S. Bradley, & Beth A. Smith

Faculty advisor: Beth A. Smith

Abstract type: Study protocol

Background: Infants at elevated risk of autism spectrum disorder (ER-ASD) are characterized as having atypical gaze behavior, delayed achievement of motor milestones, and lower executive function performance. However, these descriptive characteristics do not explain the processes engaged in acquiring motor skills for infants at ER-ASD. **Purpose**: Hence, we propose to describe differences in visual behavior during a contingency learning paradigm in infants at ER-ASD compared to infants at community level risk. **Methods**: Infants will engage in a contingency learning paradigm where right leg movements will be reinforced by activating a robot to clap and laugh (robot reward). For all infants, we will detect leg movements using wearable sensors (Opal) and timing of visual gazes directed at the robot using head-mounted eye tracking (Positive Science). Infants will wear Opal sensors on their ankles to detect leg movements and a Positive Science eye tracking system on their head to record visual gaze. A 50% increase in right leg movement from baseline will be defined as learning during the contingency. Timing of gaze onset directed to the robot will be used to identify predictive gaze behavior, defined as gaze directed to the robot's arms or face after leg movement but before onset of the robot reward.

Results: We hypothesize that infants at ER-ASD will be less likely to learn the contingency and will exhibit fewer instances of predictive gaze. **Conclusion**: Results from the proposed study will provide foundational information about infant motor learning in those at ER-ASD.

Poster #107

Title: Clinical estimation of hip and knee extensors during athletic movements

Authors: Rachel K. Straub, Alex Horgan, Adam J. Barrack, Leana Mosesian, & Christopher M. Powers

Faculty advisor: Christopher Powers

Abstract type: Research

Background: Previous studies have indicated that increased use of the knee extensors relative to the hip extensors may contribute to various knee injuries. There is a need for a clinic friendly method to characterize movement behavior that may expose individuals to knee injury. **Purpose**: To determine whether the difference between sagittal plane trunk and tibia orientations obtained from 2D video (2D trunk-tibia) could be used to predict the average hip/knee extensor moment ratio (HKR) during athletic movements. **Methods**: Thirty-nine healthy athletes (15 males, 24 females) participated. Lower-extremity kinematics and kinetics (3D) and sagittal plane video (2D) were collected simultaneously while subjects performed 6 tasks (Step Down, Drop Jump, Lateral Shuffle, Deceleration, Triple Hop, and Side-Step-Cut). Linear regression analysis was performed to determine if the 2D trunk-tibia angle at peak knee flexion predicted the average HKR during the deceleration phase of each task. **Results**: For each task, an increase in the 2D trunk-tibia angle at peak knee flexion predicted an increase in the average HKR when adjusted for body mass (all $p < 0.013$, $R2$: 0.17 to 0.77). The 2D trunk-tibia angle cut-offs necessary to achieve a hip extensor biased movement strategy (average HKR > 1.0) ranged from -2° for the step down and 31° for the triple hop. **Conclusion**: The 2D trunk-tibia angle at peak knee flexion represents a practical method to characterize movement behavior that may expose individuals to knee injury.

Poster #108

Title: Flexible reversal of responsibility assignment for bimanual errors after stroke

Authors: Rini Varghese, James Gordon, Nicolas Schweighofer, & Carolee Winstein

Faculty advisor: Carolee Winstein

Abstract type: Research

Skilled human action is seldom unimanual and often involves coordination of both hands. A critical aspect of bimanual coordination is responsibility assignment. How does the nervous system assign responsibility when an error occurs? The optimal feedback control theory suggests that responsibility assignment is a flexible process such that errors are assigned to and corrected for by the limb that is most likely to produce those errors. In right-handed adults,

this is often the less-skilled, non-dominant left limb. More interestingly, the flexibility of this process can be probed by examining corrections made by each limb after they have acquired alternative use-dependent experiences, e.g., if the left limb became more skilled, experiencing fewer errors or if the right limb became less skilled, experiencing more frequent errors. Such is the case of stroke affecting the right side of the body, wherein we would predict that the left limb corrects less while the paretic right limb corrects more for task error. In this study, we tested this prediction in 20 individuals with an intact sensorimotor system, as well as 23 chronic stroke survivors (12 right hemiparesis). Our data supported our predictions for those with right hemiparesis who not only corrected more with their paretic right limb within a trial, but also corrected less with their now more skilled left limb. They also systematically adapted to these errors in a feedforward manner over trials. The extent of correction and adaptation in stroke survivors varied with the degree of motor impairment of the paretic extremity.

Poster #109

Title: Gluteal activation reduces acetabular contact pressure in femoroacetabular impingement syndrome

Authors: Jordan Cannon & Christopher M. Powers

Faculty advisor: Christopher Powers

Abstract type: Research

Background: Symptomatic impingement between the aspherical femoral head and acetabular rim in persons with femoroacetabular impingement syndrome (FAIS) occurs with the motions of internal rotation and adduction when the hip is in a flexed position. The gluteus maximus and gluteus medius may protect against impingement given their ability to produce hip external rotation and abduction motion during tasks requiring deep hip flexion. **Purpose**: To determine if targeted gluteal muscle activation during squatting can reduce impingement kinematics and peak acetabular contact pressure. **Methods**: One male with a diagnosis of FAIS participated in this pilot study. Kinematic, kinetic, and surface EMG of 6 hip muscles were collected during two bodyweight squat tasks, one with and one without gluteal activation cues. A 3D finite element (FE) model of the hip joint was developed with participant-specific input parameters including hip joint kinematics, bone-on-bone contact forces (estimated from an EMG-driven model), and bony geometry (obtained via CT scans). Peak contact pressure was analyzed at peak hip flexion during each of the squat conditions. **Results**: Hip flexion and abduction were similar between squat conditions, however internal rotation was reduced by 7° during the trials with the gluteal activation cues. In the cued trials, peak acetabular contact pressure decreased from 8.49 to 3.84 MPa. **Conclusions**: Our preliminary results suggest that gluteal activation cueing during squatting reduces hip internal rotation which in turn reduces peak acetabular contact pressure. This highlights the importance of the gluteal musculature's ability to minimize impingement and associated loading during squatting in FAIS.

Poster #110

Title: Infants learn to adjust leg movements in an acceleration range

Authors: Weiyang Deng, Barbara Sargent, Nina Bradley, Marcelo Rosales, José Carlos Pulido, Maja Matarić, & Beth A. Smith

Faculty advisor: Beth Smith

Abstract type: Research

Background: Learning movement control is a fundamental process integral to infant development. However, it is still unclear how infants learn to control leg movement. **Purpose**: To determine if infants can adjust leg acceleration relative to a specified target range in a contingency learning paradigm. **Methods**: Ten 6 to 8-month-old typically-developing infants participated in the study. A robot provided reinforcement when the infant's right leg acceleration fell within the range of 9 to 20 m/s^2. If infants increased leg accelerations in this band, they were categorized as performers. The magnitude of leg peak acceleration, ratio of right/left leg acceleration peaks, and distribution of leg peak acceleration data were compared between baseline and contingency conditions. **Results**: Six infants were categorized as performers. Comparing baseline to the contingency condition, the performer group increased the magnitude of acceleration (from 2.687 ± 1.135 m/s^2 to 4.312 ± 2.091 m/s^2, p= 0.03) and proportion of target acceleration (from 6.61% ± 7.53% to 17.56% ± 11.56%, p= 0.03) for right leg, and ratio of right/left leg acceleration peaks within the target range (from 0.87 ± 0.52 to 2.32±1.88, p= 0.04). **Conclusion**: Infants specifically adjusted their right leg acceleration in response to a reward. Further study is needed to understand how control of lower limb movement may influence developmental trajectories.

BIOKINESIOLOGY & PHYSICAL THERAPY PHD & MS STUDENTS

Poster #111

Title: Analytic stability and neural correlates of peak alpha frequency

Authors: Natalie J. McLain, Moheb S. Yani, & Jason J. Kutch

Faculty advisor: Jason J. Kutch

Abstract type: Research

Several studies have found evidence of slowed resting-state peak alpha frequency (rs-PAF) in chronic pain populations. However, the stability of rs-PAF from different analytic pipelines used in the pain literature has not been determined and underlying neural correlates of PAF have not been sufficiently substantiated in humans. Here we examine a range of analytic pipelines and the relationship of PAF to activity in the thalamus, a hypothesized generator of PAF. We collected resting-state functional magnetic resonance imaging (rs-fMRI) data and subsequently 64 channel resting-state electroencephalographic (EEG) from 48 healthy men. We identified important variations in EEG preprocessing pipelines for rs-PAF from a review of 10 papers investigating the relationship between chronic pain and PAF. We tested three progressively more complex pipelines: 1) Pipeline notch filtering only, 2) Pipeline 1 and data re-referencing, and 3) Pipeline 2 and automatic artifact removal. Data for all three pipelines were then processed by the center-of-gravity (COG) method to determine peak frequency at each electrode. For all pipelines, a single principal component, well-represented by the average rs-PAF across all electrodes (global rs-PAF), explained <95% of the variance across participants. We also found that the global rs-PAF was highly correlated among the analytic pipelines (<0.95); re-referencing was the analytic step with greatest impact. We additionally found interindividual differences in global rs-PAF were significantly correlated with differences in fMRI-estimated activity in the thalamus. These results suggest that rs-PAF is a stable marker with respect to analysis method and reflects interindividual differences in brain function.

Poster #112

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

Authors: Yannick Darmon,Victor Barradas, & Nicolas Schweighofer

Faculty advisor: Nicholas Schweighofer

Abstract type: Research

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 concurrently with the prime movers of the movement. The 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 call diaschisis. Damage in the cerebro-cerebellum pathways may, therefore, precludes stroke survivors from updating their feedforward controllers. **Purpose**: In this experiment, we investigate whether stroke survivors still compensate for interaction torques during single-joint movements. **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.

Poster #113

Title: Do females exhibit elevated patellofemoral stress following ACL reconstruction?

Authors: Thomas Demirjian & Christopher Powers

Faculty advisor: Christopher Powers

Abstract type: Study protocol

Background: Tears of the anterior cruciate ligament (ACL) are among the most common traumatic knee injuries in the United States with an incidence of 100,000-200,000 cases annually. ACL reconstruction (ACLR) is the gold standard treatment approach, however, approximately 36% of individuals that undergo ACLR will be diagnosed with early-onset patellofemoral joint (PFJ) osteoarthritis. It is conceivable that elevated PFJ loading during the first year post-ACLR may be contributory to early-onset cartilage changes. **Purpose**: To compare PFJ stress during walking, running, and jumping between females who have undergone ACLR and a healthy control group. **Methods**: Twenty female athletes who have undergone ACLR within 4 months and 20 healthy females will undergo magnetic resonance imaging (MRI) and biomechanical evaluation. Lower extremity kinematics, kinetics, and EMG of the knee flexors will be obtained during walking, running, and a drop jump. Axial plane MR images (loaded, 20% bwt) will be obtained 0°,20°,40°,60° of knee flexion to acquire patellofemoral contact area. A previously described biomechanical model will be used to calculate PFJ stress (force per unit area). Peak PFJ stress will be compared between groups across tasks using 2-factor ANOVA. **Results**: Compared to the healthy control group, females following ACLR will exhibit greater PFJ stress across all tasks. Increased PFJ stress in the ACLR group will be the result of elevated PFJ reaction forces and diminished PFJ contact area. **Conclusion**: The results of the current study will support the premise that early-onset PFJ OA may be due to elevated PFJ loading during the post-operative period.

Poster #114

Title: Effects of continuous athletic activity on feedforward control of jumping

Authors: David Ortiz-Weissberg, Christopher Laine, Hai-Jung (Steffi) Shih, Amanda C. Yamaguchi, & Kornelia Kulig

Faculty advisor: Kornelia Kulig

Abstract type: Research

Background: Feedforward control represents attempts of the nervous system to predict upcoming demands and is integral to preparing for transitions between swing/flight and ground contact phases. There is limited research on how continuous athletic activity affects feedforward control. The requirements of dancers to maintain aesthetics makes them an exemplar for this research. **Purpose**: To investigate the influence of continuous activity on feedforward control. **Methods**: We collected surface EMG on the medial gastrocnemius (GasMed), peroneus longus (PL), and soleus (Sol) as 12 dancers performed rate-controlled sauté jumps interspersed with choreography. Muscle variables: pre-activation(flight phase) median frequency, amplitude, onset latency. Kinematic variables: ankle sagittal plane angle at initial ground contact, maximum excursion into dorsiflexion during ground contact. Linear mixed effects models assessed relations between accumulated activity, EMG, and kinematics. **Results**: The median frequencies decreased significantly (slopes: -3.0 to -1.2 Hz over 30 sautés). The ankle plantar flexion angle at initial contact and dorsiflexion excursion during ground contact decreased significantly (slopes: 0.14°, -0.08° over 30 sautés; + = dorsiflexion). The initial contact angle was negatively correlated with PL and Sol amplitude (slopes: 0.6°, 0.9°/10% MVIC amplitude increase). Dorsiflexion excursion was positively correlated with GasMed pre-activation onset latency(slope: 1.3°/10% increase in onset latency). **Conclusion**: Dancers displayed altered pre-landing muscle activity and minor changes in ankle kinematics. The mild drop in muscle frequency indicates some alteration in muscle coordination, and it is possible this coordination change prevented early task cessation. The minor changes in kinematics indicate the dancers maintained their aesthetics even with this low level of muscle fatigue.

Poster #115

Title: Golf – The next novel activity intervention for breast cancer survivors?

Authors: Guanrong Cai & George Salem

Faculty advisor: George Salem

Abstract type: Theoretical model or novel technique

Background: Breast cancer survivors (BCS) face declines in numerous physical, psychosocial, and cognitive outcomes and an increase in comorbid conditions, which are exacerbated by sedentary behaviors. Evidence demonstrates that traditional and non-traditional physical activities are beneficial to health outcomes in BCS. Two recent studies (GIVE and GHA) from our research team found that golf is a multimodal activity that is safe, feasible, and contributes to improved health outcomes in healthy older adults (OAS, age range: 59-80), an age group where BC diagnoses are prevalent. However, golf has never been formally investigated in BCS. **Purpose**: This report aims to propose that a comprehensive golf training program (CGTP) be considered as a novel activity intervention for BCS. **Methods**: GIVE (12 weeks) and GHA (10 weeks) compared within-subjects physical and cognitive measures in healthy OAS (novel to golf), before and after a CGTP. The CGTP consisted of warm-up exercises, driving range practice, and golf play twice/week for 90 minutes. Both studies had high attendance rates and no golf-related adverse events, demonstrated improvements in outcomes of physical tests, balance, cognitive batteries, and social wellbeing. **Results**: A large portion of BCS is also considered OAS, therefore, the benefits observed in our previous studies may translate to BCS. Investigating the efficacy of a CGTP in BCS would provide clinicians with evidence regarding the feasibility, safety, and efficacy of a novel activity designed to combat sedentary behaviors and potentially provide a solution to long-term lifestyle modification, which is key to high quality of life among BCS.

Poster #116

Title: Investigating speed-dependent changes in kinematics: comparing age-matched and post-stroke gait

Authors: Sarah A. Kettlety, Catherine G. Broderick, James M. Finley, Darcy S. Reisman, & Kristan A. Leech

Faculty advisor: Kristan Leech

Abstract type: Research

Clinical practice guidelines recommend high-intensity training at fast speeds to address activity limitations in people post-stroke. Walking at fast speeds can also improve kinematic metrics without increasing compensatory movements. However, it is unclear if these improvements result in kinematics similar to controls. We aimed to determine if walking at faster speeds changes the magnitude of kinematic differences between people post-stroke and age-matched controls. We hypothesize that this difference will increase as speed increases. We performed a secondary analysis of 3 datasets. After combining datasets, we had 28 people post-stroke and 26 age-matched controls that walked on a treadmill at 4 different speeds. Linear mixed-effects models were used to evaluate the effect of speed and group on circumduction, hip hiking (HH), trailing limb angle (TLA), and peak knee flexion angle (pKF). People post-stroke had greater circumduction($p=0.02$) than controls with no effect of speed(speed: $p=0.41$, speed x group: $p=0.54$). People post-stroke also had greater HH ($p<0.001$) than controls, and post-stroke HH increased with faster speeds (speed x group: $p=0.005$). Controls had greater TLA ($p<0.001$) and pKF ($p<0.001$) than people post-stroke. We found that controls increased pKF at a faster rate with increased speeds than people post-stroke (speed x group: $p<0.001$). Conversely, people post-stroke increased TLA at a faster rate than controls(speed x group: $p=0.001$). Walking at faster speeds increased TLA and pKF. However, between-group differences in pKF became larger at faster speeds with people post-stroke exhibiting smaller pKF. This suggests that pKF deficits post-stroke may not be adequately addressed by fast walking, and may need to be specifically targeted.

Poster #117

Title: Low-load with BFR vs high-load without BFR eccentric hamstring training

Authors: Malcolm J Jones, Jesus F. Dominguez, Clarizzah Macatugal, Keairez Coleman, & E. Todd Schroeder

Faculty advisor: E. Todd Schroeder

Abstract type: Research

A key principle of hamstring injury rehabilitation is developing high eccentric force capability through resistance training (RT). However, serious hamstring injuries can take months before high-load RT is appropriate. Low-load blood flow restriction (BFR) RT has been identified as an effective alternative when high-load RT is contraindicated but has been scarcely investigated in the hamstring. We sought to determine the effect of longitudinal BFR RT on eccentric hamstring strength, hypertrophy, endurance, and power while assessing muscle soreness and acute muscle swell. Healthy adults (n=40; 19F,21M; mean±SD; age:24.3±2.6 years) participated to compare the outcomes of low-load (30% 1RM) eccentric lower extremity training with BFR (BFR-ELET) to traditional high-load (80% 1RM) eccentric lower extremity training (CON-ELET) without BFR biweekly for 6 weeks. Outcomes were tested pre/post intervention with significance at $\alpha=0.05$. Both interventions elicited gains ($p<0.001$) in concentric strength (BFR-ELET 7.7±4.3%; CON-ELET 12.2±4.2%) and eccentric strength (BFR-ELET 7.1±4.3 %; CON-ELET 9.9±4.3%), with no differences between interventions. There were also improvements in muscle endurance and leg power without significant differences between interventions. Single leg, lean mass did not significantly change with either intervention. There was, however, significant acute muscle swelling with BFR-ELET ($p<0.001$) that has been linked to protein synthesis. We conclude that low-load BFR training is a successful alternative modality for effecting optimal eccentric hamstring strength gains. With the prevalence of hamstring injury across sports, BFR eccentric RT may be useful since it can be implemented during the early phases of rehabilitation when high-load training is contraindicated.

Poster #118

Title: Maximal power production in the mid-thigh power clean

Authors: Antonio Squillante, Brady McCormick, Lorena Martin, Susan Sigward, & E. Todd Schroeder

Faculty advisor: E. Todd Schroeder

Abstract type: Research

Background: Evidence suggests the importance of prescribing optimal load to maximize peak power output in explosive strength training for sports. However, conflicting results exist on the effect of loading on peak power output in the mid-thigh power clean (MTPC). **Purpose**: To determine the optimal load to maximize peak power output in the MTPC. **Methods**: 26 male and female weightlifters (age 25.5±3.8, height 168.2±4.6 cm, body mass 76.7±4.6 kg) were tested in the MTPC for incremental loads of 20%, 30%, 40%, and 50% of the barbell back squat 1RM. Participants performed 4 sets of 3 repetitions standing on a force platform sampling at 1000Hz (AccuPower, Advanced Mechanical Technology, Inc., Watertown, MA). Peak vertical bar velocity was measured using a wearable accelerometer placed on the barbell (Push 2.0). **Results**: Findings with p-value set to $p\leq0.05$ reveal that peak power output in the MTPC (3,625±1,326 W) occurs for loads equal to 20-30% of the barbell back squat 1RM. Peak power output occurs when neither force (3,522±1,285 N) nor peak vertical bar velocity (2.19 m·sec-1±0.38 m·sec-1) is at its peak. A one-way repeated-measures analysis of variance revealed a significant difference between peak power output at 20% and 30% of the barbell back squat 1RM compared to loads at 50%, F(3,75) = 5.74, p <0.05. **Conclusion**: Peak power output in the MTPC occurs for loads equivalent to 20-30% of the barbell squat 1RM with no significant difference between men and women. These findings suggest no additional benefit of training for power at greater intensities.

Poster #119

Title: Producing high-intensity interval training protocols from heart rate maximum testing

Authors: Jared Moore, Garry Cai & George Salem

Faculty advisor: George Salem

Abstract type: Study protocol

Background: High-intensity interval training (HIIT) is becoming more common as an exercise modality due to the ability to feasibly and safely train at high intensity in a short amount of time. Many studies have been done to examine inflammatory and muscle damage responses to endurance training; however, that methodology is difficult to perform without high level athletes. **Purpose**: This work will showcase the use of heart rate maximum (HRmax) testing to determine treadmill speed and cycle ergometer resistance for HIIT. These protocols will be used to elicit training at specific heart rate ranges to study the inflammatory and muscle damage biomarkers associated with acute exercise. **Methods**: HRmax testing will be performed by healthy, young (18-30 years) participants on a treadmill and cycle ergometer. The heart rate values measured will be used to produce 4x4 HIIT protocols at 85-95% HRmax for active inter-

vals and 60-70% HRmax for active recovery intervals. **Results**: There will be no adverse events from the HRmax and HIIT protocols. Treadmill speed and cycle resistance will be effectively transitioned from HRmax test to the HIIT protocols. Participants will reach anticipated heart rate intervals with these HRmax test values. **Conclusion**: HRmax testing in healthy, young adults will be safe and feasible. These measurements will allow the accurate production of HIIT protocols for each individual to reach specific heart rate ranges. This data will be used to build an effective protocol for eliciting high intensity exercise for measurement of the inflammatory and muscle damage responses to acute exercise.

Poster #120

Title: Repetitive occupational tasks: effects on shoulder pain and tendon morphology

Authors: Daniel Awokuse, Federico Pozzi, Catarina O. Sousa, Hillary A. Plummer, Brittany Andrade, Naoko Kono, Wendy J. Mack, Shawn C. Roll, & Lori A. Michener

Faculty advisor: Lori Michener

Abstract type: Research

Repetitive upper extremity tasks are a risk factor for developing shoulder pain. Dental hygienists have repetitive job-related tasks and report a high incidence of shoulder pain. Here we assess the association between the incidence of shoulder pain and tendon morphology. **Methods**: Dental hygienist (DH,n=45) and occupational therapist (OT,n=52) students were recruited. Collected at baseline and 12-months: shoulder pain with a visual analog scale (VAS), ultrasound images of supraspinatus thickness. The VAS minimal detectable change identified participants that developed shoulder pain after 12 months(DH-pain). **Results**: Shoulder pain incidence was higher in DH students [relative risk=4.0 (95%CI:1.4,11.4)]. After 1 year, DH-pain had the greatest thickening of the supraspinatus tendon [0.7mm (95%CI:0.4,0.9mm)]. The change in supraspinatus thickness of DH-pain was greater than both DH-no pain [0.4mm (95%CI:0.1,0.8mm)] and OT students [0.9mm (95%CI:0.5,1.2mm)]. At 12 months, greater supraspinatus thickness was related to greater shoulder pain (r=0.29; p<0.01). DH students with increased tendon thickness indicating tendinopathy (>0.8mm) were likely to develop shoulder pain [relative risk=1.9 (95%CI=1.0,3.6)]. **Conclusions**: DH students are at higher risk of developing shoulder pain after 12 months of training. The development of shoulder pain is associated with an 18% thickening of the supraspinatus tendon. These morphological changes in the supraspinatus are compatible with signs of supraspinatus tendinopathy.

Poster #121

Title: Shoulder rotational strength profiles in professional baseball players

Authors: Adam J. Barrack, Bernard Y. Liebeskind, Ryan J. Zerega, Jonathan C. Sum, Ryan L. Crotin, Hillary A. Plummer, Christopher M. Powers, & Lori A. Michener

Faculty advisors: Lori Michener & Christopher Powers

Abstract type: Research

Background: Musculature of the shoulder acts to accelerate, decelerate and stabilize the arm during throwing. Shoulder strength measures can be leveraged to identify deficits that may explain changes in performance and injury risk. Previous studies of professional baseball players have not distinguished strength across geographic areas of origin, and often only consider pitchers. **Purpose**: To characterize the effects of player position (Pitcher, Position Player) and geographic origin (North American (NA), Latin American (LA)) on shoulder external (ER) and internal (IR) rotation strength in professional baseball players. **Methods**:Professional baseball players (N=242, N=135 Pitchers, N=162 NA) participated. Players completed two trials of maximal isometric ER and IR strength (at 0° arm abduction) using a handheld dynamometer. Strength data were normalized to body weight. **Results**: Position players were significantly stronger in ER [MD=0.28N/kg; p<0.001] and IR [MD=0.29N/kg; p<0.001] with higher ER:IR strength ratios [0.77±0.17 vs. 0.73±0.14; p<0.043] compared to pitchers. LA athletes were stronger in ER [MD=0.3N/kg; p<0.001) and IR [MD=0.2N/kg; p<0.001] compared to NA athletes. Specifically, LA pitchers were stronger in ER [MD=0.4N/kg; p=0.002] and IR [MD=0.2N/kg; p=0.006] compared to NA pitchers. **Conclusion**: Player position and geographic origin influence shoulder rotational strength values in professional baseball players. Position players have 14 –20% higher rotational strength than pitchers. Moreover, Latin American pitchers have 12.5% ER and 14.3% IR higher throwing arm strength than their North American counterparts. These normative values can be used to determine player deficits, declines in performance, targets for return to play after injury, and advance strength and conditioning practices.

Poster #122

Title: Visuomotor control in infants at elevated risk for autism

Authors: Judy Zhou, Carolee J. Winstein, Rujuta B. Wilson, & Beth A. Smith

Faculty advisor: Beth Smith

Abstract type: Study protocol

Background: Motor deficits are common in children with and at elevated risk for autism spectrum disorder (ASD). Studies in 4-5-year-old children and adults with ASD show both motor planning and motor execution deficits. Although there is some evidence of motor deficits in infants at elevated risk, deficits in motor control are not well identified. **Purpose**: Compare developmental trajectories of visuomotor planning and execution in infants at elevated and low risk for ASD. **Methods**: We will measure motor planning and execution using a reach-to-grasp task with an object of changing orientation (vertical and horizontal) at 6, 7.5, and 9 months of age. We will use 3-D motion capture to measure the following variables for motor planning: latency to movement onset, reach trajectory error, hand orientation error, and motor execution: movement duration, post-contact hand orientation adjustment, movement units. We will test for a group effect and a group-by-time interaction. **Results**: Infants at elevated risk demonstrate significantly lower performance on all motor planning and execution measures compared to infants at low risk (group effect), and that group differences will widen over time between 6 and 9 months of age (group-by-time interaction). **Conclusion**: Infants at elevated risk demonstrate impaired motor planning and execution starting at 6 months of age. These results support that early motor control intervention should be considered beginning at 6 months of age for infants at elevated risk for ASD. Ultimately, this may help minimize cascading motor deficits which can exacerbate the social, communicative and cognitive symptoms of ASD.

BIOKINESIOLOGY & PHYSICAL THERAPY POSTDOCS & PT RESIDENTS

Poster #123

Title: Motor intervention forinfants with cerebral palsy: a systematic review

Authors: Aubrey Baker, Natalie Niles, Lynn Kysh, MLIS, & Barbara Sargent

Faculty advisor: Barbara Sargent

Abstract type: Research

Background: Cerebral palsy (CP) is a lifelong movement disorder caused by damage to the developing brain. **Purpose**: This systematic review's objective is to evaluate the effect of motor intervention on motor outcomes of children with or at high risk of CP aged 0 to 3 years. **Methods**: Nine databases were searched for randomized control trials (RCTs) on motor outcomes of motor interventions for children with or at high risk of CP. Level of evidence and risk of bias were assessed. **Results**: Twenty-five RCTs included 811 children with or at high risk of CP. Interventions included: Constraint-Induced Movement Therapy (CIMT, n=5), motor learning approaches (n=14), Neuro-Developmental Treatment (NDT, n=3), and lower extremity activities (LE, n=2). Results support that CIMT improved hand function of the more-affected hand (small to moderate effect size) and motor learning improved fine and gross motor function (moderate effect size). No effects were found for NDT and LE. **Conclusion**: CIMT and motor learning approaches are recommended to improve motor function of infants with or at high risk of CP. Further research is recommended.

Poster #124

Title: Wearable multi-sensor system for stroke rehabilitation: validity and usability

Authors: Demers Marika, Bishop Lauri, Rowe Justin, Zondervan Daniel, & Winstein Carolee

Faculty advisor: Carolee Winstein

Abstract type: Research

Background: One of the most impenetrable problems after stroke is the gap between motor capacity and the amount of motor activity performed in the community. Few wearable systems exist for accurately measuring upper (UL) and lower limb (LL) activity in an unsupervised community setting, especially for individuals with motor impairments. **Purpose**: To develop a wearable, multi-sensor system that accurately measures UL and LL activity, while leveraging end-user feedback to optimize usability. **Methods**: Twenty chronic stroke survivors were outfitted with 5 wearable sensors (MiGo; wrists, ankles and more affected hip). Participants performed the Chedoke Arm and Hand Activity Inventory (CAHAI) and a 2-minute walk test (2MWT). For the CAHAI, MiGo measured the active movement time. For the 2MWT, MiGo measured step counts and stance time symmetry. For validity, we determined the agreement between the wearable system measures and gold-standards for locomotion (APDM sensors) and arm/hand actions (video annotation). Usability was assessed through end-user feedback. **Results**: Agreement between the gold-standards and MiGo ranged from 68.5-75.2% for step counts, 99% for stance time symmetry and UL active movement time. Social acceptability and perceived usability were high, with 95% of participants indicating a willingness to use all 5 sensors daily. However, 10% of participants experienced difficulty to independently don/doff the sensors. **Conclusion**: The wearable system accurately measured active UL movement time and stance time symmetry with high perceived usability. The choice of the APDM sensors as the gold-standard may have contributed to the lower accuracy for step counts and requires further investigation.

BIOKINESIOLOGY & PHYSICAL THERAPY AFFILIATES

Poster #125

Title: The pitcher-specific relationship between pitch velocity and elbow valgus torque

Authors: Garcia NS, Lobb NJ, Barrack AJ, Zerega RJ, Yasen A, Rittenberry HB, Karim R, Karduna AR, & Michener LA

Faculty advisor: Lori Michener

Abstract type: Research

Background/Purpose: Ball velocity and the prevalence of ulnar collateral ligament (UCL) reconstruction have increased among Major League Baseball pitchers. Given that the UCL provides 54% of resistance to elbow valgus torque during pitching, torque can be used as a surrogate to quantify UCL injury risk. The between-subject relationship between ball velocity and elbow valgus torque is low and highly variable when looking at individual pitchers, indicating that the torque-velocity relationship may be pitcher-specific. Here we analyze the between and within-pitcher relationship between torque and velocity. **Results**: Across pitchers, velocity was significantly related to elbow varus torque (R^2= 0.17; Beta= 0.009; p= 0.034). For within-subjects, 13 (48%) pitchers had a significant torque-velocity relationship [average R2= 0.72 (range= 0.47-0.90); average Beta= 0.011 (range= 0.005-0.017); $p<0.05$]. The remaining 14 (52%) pitchers did not have a significant torque-velocity relationship [average R^2= 0.15 (range= 0.001-0.33), $p > 0.05$]. Pitchers with a significant torque-velocity relationship had a significantly larger R^2 ($p < 0.001$) and slope (p= 0.01) compared to those without a significant relationship, with the intercept approaching significance (p= 0.055). **Conclusions**: The torque-velocity relationship was significant across pitchers, however this relationship appears to be largely pitcher-specific. Thirteen pitchers had a significant torque-velocity relationship with 72% of the variance explained, which was 57% higher than those 14 pitchers without a significant torque-velocity relationship. There are a number of potential factors that influence the torque-velocity relationship, including pitching mechanics and modifiable physical factors such as muscle strength and range of motion.

FROM THE **EDITORS**

To our fellow students, faculty, and staff:

It is our honor and privilege to present to you the Thirteenth Edition of The Explorer Journal of USC Student Research. In this edition, our talented student authors have brought you to the forefront of some of the innovative and game-changing research being conducted within the numerous programs at the Herman Ostrow School of Dentistry of USC, including the Mrs. T.H. Chan Division of Occupational Science and Occupational Therapy and the Division of Biokinesiology and Physical Therapy, all of which are proud members of the Ostrow family.

We would like to acknowledge the wonderful discoveries of all our fellow classmates and faculty that are engaged in research and those who continue to make meaningful breakthroughs for our profession. Despite the limitations imposed by the COVID-19 pandemic, we want to recognize the hard work and dedication that our classmates, faculty, and staff demonstrated during this time. Our keynote speakers 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 - whether it may be from restorative dentistry to occupational therapy or to biokinesiology to name a few, we hope the projects presented in this journal will spark curiosity and interest in pursuing research.

Lastly, we would like to thank everyone who has helped in organizing Research Day. The success of 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 that have worked tirelessly behind the curtains in order to host Research Day virtually and make today a success. We are also very fortunate to have an amazing group of writers, photographers and leaders in Student Research Group without whom this journal would not be possible. We hope you enjoy this issue of The Explorer!

Thank you so much for all the support, and Fight On!
Teresa Nguyen & Chenxin Li
Presidents / Editors in Chief

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