

A fluorescence microscopy image of tissue, likely dental or biological in nature. The image shows a dense network of cells and fibers. A prominent feature is a large, elongated, and somewhat curved structure in the center, which is densely packed with cells. This structure is stained with a bright green dye, possibly indicating a specific cell type or protein expression. The surrounding tissue is stained with a mix of red and blue dyes, creating a complex, textured background. The overall appearance is that of a histological section viewed under a fluorescence microscope.

Volume 11, April 2019

THE EXPLORER

Journal of USC Student Research

Herman Ostrow School of Dentistry of USC

IN THIS ISSUE

05

FROM THE DEAN

Avishai Sadan, DMD, MBA
Dean

Herman Ostrow School of Dentistry of USC

07

INTRODUCTION TO

RESEARCH DAY

Yang Chai, DDS, PhD

Associate Dean of Research

Herman Ostrow School of Dentistry of USC

34

RESEARCH DAY

Schedule of Events

35

RESEARCH DAY

Keynote Speakers

Carl Kesselman

Neema Bakhshalian

Pinghui Feng

Lisa Aziz-Zadeh

36

POSTER CATEGORY AWARDS

37

PHOTO CREDITS

38

RESEARCH DAY ABSTRACTS

Dentistry Division Faculty

Advanced Specialty Program Residents

Dental Hygiene Students

CBY/PIBBS Graduate Students

Dentistry/CCMB Post-Doctoral Fellows

Undergraduate & DDS Students - Basic Sciences

Undergraduate & DDS Students - Clinical Sciences

Other Affiliated Dentistry/CCMB Researchers

Biokinesology & Physical Therapy Faculty

Biokinesology & Physical Therapy PhD Candidates

Biokinesology & Physical Therapy PhD Students

Other Biokinesology & Physical Therapy Researchers

Occupational Science & Occupational Therapy Faculty

Occupational Science & Occupational Therapy Doctoral
Students

Occupational Science & Occupational Therapy Post-Doctoral
Fellows

Occupational Science & Occupational Therapy Professional
Students

76

FROM THE EDITORS

Ruhee Jaffer DDS 2019

Yeonghee Jung DDS 2020

78

RESEARCH DAY PLANNING COMMITTEE

Photo Courtesy Mehrdad Razaghy DDS 2019

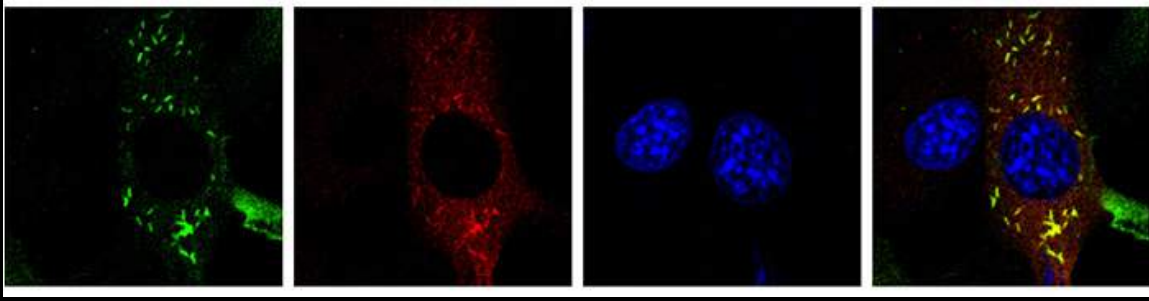


Photo Courtesy Dr. Jun Zhao

DIVISION ARTICLES

08

New USC Chan Study Probes
the Sensory Effects of Prenatal Alcohol Exposure

Katharine Gammon

10

The Therapeutic Effects of Golf

Dr. George Salem & Kiran Kanwar

12

Student Spotlight: Mehrdad Razaghy DDS '19

Ruhee Jaffer

14

Understanding Skeletal Development and
Disease

Simon Youn & Connor Yim

16

The Role of Protein Deamidation in
Viral Infections & Tumorigenesis

Teresa Nguyen

18

Oral Radiography: Leading the Transformation
from Clinician to a Diagnostician

Azzah Widadalla

20

The Science Behind Curing Lights
& Composite Materials

Sara Kahng

22

A Resolution for Dental Public Health

Nirav Patel & Rajdeep Batth

24

Caring for the Pediatric Community

Ana Zapata Caceres & Chenxin Li

26

Rafael Roges: Teaching with a Purpose

Nina Bubalo & Nathan Nourian

28

Zen and the Art of GPR Program Management

Meredith Messerle & Abigail Heleba

30

Technology-Driven Changes in Oral Surgery Education.

Scott Barlow & Jiawei Li

32

Redefining Patient Care by Digitizing Orthodontics

Meera Sravan Kumar & Neha Agarwal



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 students and colleagues,

Welcome to Research Day 2019, one of the university's only days devoted exclusively to faculty and student inquiry and discovery.

The importance of conducting research cannot be overstated. Research is our professions' fuel, launching us into ever-exciting and sometimes unexpected directions.

Being successful in any profession will require in you an insatiable thirst for new knowledge. You must constantly consume new research, understand new technologies and be willing to evolve in the way you practice. Participating in Research Day prepares you to do just that and, better still, to be savvy scientific investigators while doing it.

As part of a research-intensive university, we at Ostrow take scientific inquiry and discovery very seriously. As many of you might know, Ostrow has consistently been one of the nation's top-funded dental schools by the National Institute of Dental and Craniofacial Research. There's no greater vote of confidence than having this national organization believe so strongly in the work our researchers do every day.

Our commitment to research doesn't stop there. Our colleagues at the USC Chan Division of Occupational Science and Occupational Therapy and the USC Division of Biokinesiology and Physical Therapy are also among their professions' thought leaders. Last year, USC Chan — one of the nation's top-ranked occupational therapy programs by the U.S. News & World Report — received seven new federal grants, giving Chan researchers more than \$11 million in active federal grants. The USC Division of Biokinesiology and Physical Therapy, which has been consistently ranked No. 1 by the U.S. News & World Report since 2004 — received nine new federal grants, giving them nearly \$20 million in active federal grants.

Today, I encourage each of you to not only spend time looking at your colleagues' posters but also spend some time looking at the research presentations from the other professions as well. Try to understand what challenges they face and the ways in which they hope to overcome them. This will give you the ultimate leg-up in your careers as health care professions continue their push toward integrated, team-based care. I hope that you walk away from today having learned something new. I know I always do.

Finally, I would like to congratulate all our faculty and student researchers. I am incredibly proud of your hard work, dedication and your scientific curiosity. Your ideas today could be tomorrow's next great breakthrough, and that is truly exciting.

Fight On!

Herman Ostrow School of Dentistry of USC

INTRODUCTION TO RESEARCH DAY

Dear Colleagues,

Welcome to Herman Ostrow School of Dentistry of USC Research Day 2019! Hosting this exciting event at the Galen Center is always a highlight of the year for me because it shows our school at its finest: our students, staff, and faculty in Dentistry, Occupational Science, Occupational Therapy, Biokinesiology, and Physical Therapy are second to none in their groundbreaking research endeavors. There has been an explosion in big data and bioinformatics in recent years. We have unprecedented opportunities to perform new studies that we could only dream about doing a few years ago.

It is our privilege as faculty to welcome students into our labs and clinics to conduct research during their time at USC. The students who take advantage of this opportunity should be applauded for taking the initiative, and I am confident it will pay dividends in whatever path their careers may take. At USC, we are strongly committed to promoting research that will lead to people being enabled to live healthier, more fulfilling lives. At Research Day, we showcase exactly this: research that tackles challenges facing health care providers and all kinds of people in their daily lives. We see clearly how our research advances can benefit our community and our world.

The most amazing thing about Research Day is how much time, hard work, skill, and patience went into creating the research represented here. It is a testament to the dedication of each one of our young researchers, as well as to their mentors who enable them to flourish. Together, we can have an incredible impact on human health as we look forward to shaping our future. Please join me in congratulating all of our students and researchers on their successes as we gather to showcase their efforts on Research Day.

Fight on!



Yang Chai, DDS, PhD

Professor

George and MaryLou Boone Chair in Craniofacial Molecular Biology

Director, Center for Craniofacial Molecular Biology

Associate Dean of Research

Herman Ostrow School of Dentistry of the University of Southern California

New USC Chan Study Probes the Sensory Effects of Prenatal Alcohol Exposure

KATHARINE GAMMON

Researchers have known for decades that babies born to mothers who drank heavily while pregnant have differences in brain function. Now, an innovative new study will test their sensory processing.



Dr. Stefanie Bodison

The sparkling vineyards near Cape Town, South Africa produce some of the world's best wines. But there's a darker story among the people who work and live in the sunny wineries' shadows: the region has the world's highest prevalence of fetal alcohol spectrum disorders. "The wineries are the issue because the people who work in the vines were historically paid part of their wages in wine," says Elizabeth Sowell, Professor of Pediatrics at the Keck School of Medicine of USC.

There, binge drinking on weekends — yes, even during pregnancy — is culturally acceptable. It makes the area uniquely valuable for studying fetal alcohol spectrum disorders and their subsequent effects on childhood development. That's what Stefanie Bodison '92, MA '93, OTD '10, Assistant Professor of Research in the USC Chan Division of Occupational Science and Occupational Therapy, plans to do.

Bodison was recently awarded an administrative supplement from the National Institutes of Health to join a study currently conducted by Sowell examining the interrelationships between sensorimotor integration, caregiver-reported measures of sensory processing, behavioral motor skills, and cognitive development in young children with prenatal alcohol exposure. Sowell's initial grant funded research that identified and studied a group of 6,000 kids ranging from birth to 12 years old with prenatal alcohol exposure, recruited from a clinic in South Africa's wine region that serves underprivileged families. Bodison will focus on a subset of these kids by taking a deeper look at their brain's networks and body's abilities to process sensory information.

Alcohol use around the world

Globally, prenatal alcohol exposure is the number one known cause of cognitive and behavioral impairment, Sowell explains, with effects that significantly impact brain development. But the problems related to alcohol exposure aren't evenly distributed.

"It's more prevalent in places like Cape Town and in the northern plains in U.S. Native American populations," she says. "There are pockets in the world where it's much more prevalent than others."

Research shows that binge drinking — for women, defined as four or more drinks per occasion — and regular heavy drinking put a fetus at greatest risk for severe problems, according to the National Institute on Alcohol Abuse and Alcoholism. However, even lesser amounts can cause damage.

Because the cultural stigma of drinking during pregnancy is lower relative to that in the United States, the South African mothers were especially forthcoming about their habits throughout the study, explains Sowell. “Here in the U.S., you don’t get as honest a reporting of drinking behavior during pregnancy.”

The sensory study

For Bodison’s new study component, 100 kids between 8 and 12 years old will undergo MRI scans in order for researchers to visualize brain structures and measure their volume, thickness and surface area. It can be tricky to coax a child to stay still inside a noisy, rumbling brain scanner, but the researchers have come up with some handy tricks. “We put them in a mock scanner so they can get used to the sound of the magnet moving,” explains Sowell.

Bodison will also give parents a survey that assesses their kids’ sensory systems, gathering information about sensitivity to touch, movements and loud environments, for example. Bodison will be traveling to Cape Town to work directly with a small sample of the children, and administer commonly-used motor skills tests.

“From a junior investigator perspective, this is a wonderful opportunity because I can do a study where the majority is funded,” says Bodison, acknowledging the expenses of brain imaging research. “My piece expands the scope without the cost of writing a grant.”

Building better interventions

Bodison is also an occupational therapist, and she’s interested in how the brain’s pathways and connections influence everyday activities. “Understanding these brain mechanisms will help us to create interventions to improve functions in daily life,” she says.

Kids with prenatal alcohol exposure have challenges in motor skills and self-regulation that can impact their academic achievements. Developing customized interventions for a given person or population can make a lasting difference.

Even though the participants in Bodison’s study will be between 8 and 12 years old, there is still an enormous amount of brain wiring that occurs during this developmental stage, says Sowell. “The big idea is to show that the intervention is changing circuitry in the brain that has an impact on improved functioning.”

Sowell points to brain research studies using MRI scans of young adults before and after learning a new skill, like juggling. “After they learn a new skill, you can see differences in white matter in the brain,” she says. “If we understand what circuits in the brain are affected by prenatal alcohol exposure, we can then potentially target interventions that will have a real impact on people.”

Dr. Stefanie Bodison

THE THERAPEUTIC EFFECTS OF GOLF

Dr. George Salem & Kiran Kanwar

Dr. George Salem



Raul Valdez is an older-adult (over 60 years) who was born in Los Angeles and has lived in this city all of his life. He had been toying with the idea of taking golf lessons upon retirement. Enter USC's Golf for Healthy Aging study. It might have been a match made in heaven, because, says Valdez, "I couldn't believe my luck!"

What is the study about? It is the result of some lateral thinking by Dr. George Salem, Associate Professor in the Division of Biokinesiology and Physical Therapy. Dr. Salem is a kinesiologist and biomechanist who has been developing and studying exercise interventions (e.g. yoga, resistance exercise) for older adults over the past 30 years.

He started playing golf later in life after having to give up other sport activities (basketball, running, surfing) because of injuries, arthritis, and other age-related physical challenges. Over the course of a few months, he began playing with senior golfers who also had similar physical challenges, including osteoarthritis, "bad backs", knee and hip replacements, and neurologic, cardiovascular, and orthopedic conditions. Some of his golf partners now include stroke survivors, persons with Parkinson's disease and Multiple Sclerosis (MS), and even a superior golfer with hemiparesis who plays with one arm. What did all of these golfers have in common? An immense joy and excitement about

playing the game. Come rain, wind, mud, or injuries, these older adults would do almost anything to get in their 9-18-holes of golf. Moreover, they are able to physically do things without hesitation that most seniors either cannot not do or have to do with considerable effort and caution. The best examples of these exceptional abilities are such daily activities as bending over, squatting, and carefully setting a golf ball upon a tee rising a mere 2 inches from the ground.

At some point, perhaps while searching for his ball among the trees, a "light bulb" of an idea occurred to Salem...golf play might just be the most comprehensive exercise activity that an older adult can do. How can that be? Golf is a multimodal physical activity that requires the golfer to walk at a moderate-vigorous intensity while negotiating varied and uneven terrain, hills, bushes, trees, water hazards, and sand traps. When playing golf, one needs to generate high-velocity swings which rapidly shift the body's center of mass (COM) first backward and then forward. Studies suggest that these swings require almost maximum activation of a golfer's hip muscles. The player's COM must then be stopped immediately after ball contact to prevent the golfer from falling over; thus, golf continually challenges a golfer's "dynamic" balance and may improve lower-extremity muscle power. Contrastingly, once on the green, the golfer must stabilize his or her body's COM and eliminate any unwanted movements in order to achieve an accurate putt. Thus, the act of putting challenges a golfer's "static" balance. Further, golfers often find their wayward shots on hills, in sand traps, or up against trees, sometimes requiring a combination of both static and dynamic balance to stand and hit the ball. Indeed, cross-sectional studies have demonstrated that older golfers have better static and dynamic balance, proprioception, and balance confidence than non-golfers.

Golf swings also require large ranges of motion in the joints of the trunk, legs, and arms; thus, swinging a club is likely to improve dynamic flexibility. Additionally, golf is often referred to as a "cerebral" sport because it is cognitively challenging. Golfers need to continually take into consideration their ball position, terrain type, distance to the pin, wind, rain, lighting, turf conditions, and finally their previous experiences, before selecting which club to use and how hard to swing. Golfers also must continually make decisions of whether to "go for it" by trying that difficult shot or to "play it safe" and choose an easier approach. Studies suggest that both exercise and cognitively-challenging activities support brain health and that these beneficial effects may be magnified when the two are combined.

Moreover, golf is rarely played alone but in groups of 2,3, or 4. Thus, it is a "social" sport that typically includes encouragement from fellow players and sometimes friendly (or not so friendly) banter and competition. Studies continually demonstrate that social engagement during exercise increases program adherence and overall satisfaction. Golf play can also be "titrated" so that golfers can adjust their playing time and training intensity depending upon their level of experience, skill, fitness, and health. For example, players can focus on putting alone at practice greens, swinging at a driving range (both indoor and outdoor), chipping at chip & putt facilities, and/or playing partial or full rounds. Most golf courses allow golfers to carry their clubs, push a hand cart, or ride in an electric golf cart—options which allow the golfer and instructor to vary the "intensity" and "workload" of the activity.

These observations helped Dr. Salem formulate the question...Could golf be used therapeutically to improve the health and wellness of older adults and persons with disabilities? To answer this question and test the hy-

potheses that golf play improves mobility, balance, strength, and cognition in persons not currently golfing, Dr. Salem and his two doctoral students (Andrea DuBois and Nicole Marcione), developed the Golf Intervention for Veterans Exercise (GIVE) study in collaboration with Dr. Steve Castle at the West Los Angeles Veterans Administration (WLAVA). The study was a 12-week golf intervention study for older-adult male veterans (60-80 years) who did not currently golf. The participants met with a Professional Golf Association (PGA) instructor twice-weekly, for 90 minutes at the Heroes Golf Course at the WLAVA—a nine-hole par 3 public golf course. The comprehensive program included complementary exercise training and dynamic warm-up exercises, golf skills training (in the full-swing, chipping, putting), and progressive golf play. The play began with course play on 2 holes and progressed to 9-holes of play by the 12th week. Physical function, walking ability, balance, strength, cognition and memory, were recorded from 10 participants at baseline and at the end of the 12-week program. Additionally, their total walking distance, swing count, and biomechanical demands of their golf swings were documented. The findings were extremely encouraging. Most importantly, all of the participants completed the program while attending 91% of the training sessions and there were no golf-related adverse events.

Hence, the program was feasible for these veterans and had excellent compliance. Reported average attendance for other community-based group exercise interventions is less than 70%. Biomechanical analyses revealed that the golf swing was comparable or exceeded the demands of other senior fitness/exercise activities including walking, tandem balance, and chair-stand activities. Following the 12-weeks of instruction, the participants had improved dynamic balance (5.9%), hip strength (6.5%), lower-extremity power (21%), mobility (14%), walking speed (7%), walking endurance (9%), walking dual-task performance (10%), stride length (4%), working memory (16%), and attention and focus (13%). There were no changes in grip strength or rate of hip force development.

Just as relevant, several of the participants reported how important golf had become for them, with one exclaiming that “learning to play golf had changed my life”. Another participant reported that because of the program he has “reconnected” with his daughter and now plays golf with her regularly. Also encouraging, a 6-month follow-up survey revealed that 7 of the 10 participants continued to play golf regularly.

With these impressive results, Dr. Salem sought to optimize the golf-training program and expand its application to non-veterans and community-dwelling senior women and men (60-80 years old) at a local

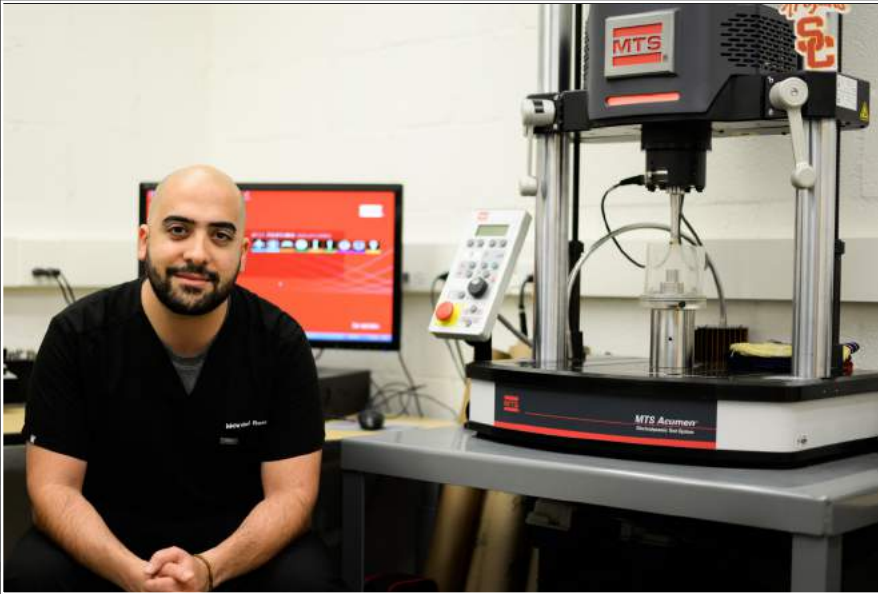
municipal golf course. He was able to obtain funding for the Golf for Healthy Aging (GHA) study from the World Golf Foundation and the Royal & Ancient (R&A) golf society. The GHA was the first health-related study ever funded by the R&A, which is the worldwide governing body of golf and is associated with 143 countries. The study is being conducted at the Monterey Park Golf Course, in Monterey Park, California (just east of the USC Health Sciences Campus). The project is being coordinated by Ms. Kiran Kanwar and assisted by research associates Jared Moore and Hyun Ji Lee. So far, 7 of 15 participants have completed the 10-week program with an impressive attendance of greater than 90%, no study drop outs, and no golf-related adverse events. Also impressive was that none of these participants had ever swung a club and two of these beginners were 80 years of age. Although only preliminary, the findings demonstrate that seniors who have never played golf can safely learn to play the sport, and that the program is compliant and improves balance, strength, mobility, walking speed, dual task processing, cognition, and attention and focus. One participant in the GHA study, Renee Martinez, the recently retired President of the Los Angeles City College District said, “I was hoping to improve my physical balance and strengthen my problem-solving skills and to my great surprise, these last weeks have proven to me that I can always succeed in a new sport when I am focused.”

The GHA program not only assesses the benefits of golf for older adults, but is also giving two masters students (Jared Moore and Hyun Ji Karen Lee) the opportunity to study important issues that aid healthy aging, while also learning how to use biomechanical and clinical tools.

Although golf has not traditionally been used therapeutically, there are new programs in the UK, Australia, Canada, New Zealand, and the US (Boston, Chicago and Los Angeles) where golf is being used to address illness and disability including dementia, Parkinson’s disease, MS, blindness, stroke, and spinal cord injuries. In October 2018, Salem attended a special session of Parliament in the UK, where a panel of experts discussed the health benefits of golf and the possibility of including golf among several physical activities UK physicians may prescribe to improve the health of their patients.

But back to our friend Raul, who never seemed to stop smiling once he was actually playing some holes on the golf course and finding he was a pretty decent golfer. “Of course, I’m not doing this for fun or diversion. It’s for science in the hope that it benefits mankind. Well, that’s what I tell my wife. But, I think she knows I’m having a great time.”

STUDENT SPOTLIGHT



With a B.S. in biological anthropology and an extensive research background, Mehrdad Razaghy achieved his long-term dream of studying dentistry at Herman Ostrow School of Dentistry at USC. After receiving his bachelor's degree, he spent a year focusing on his research in the field of neurosurgery and was part of six major publications at David Geffen School of Medicine of UCLA. His creativity and passion for research have influenced his path as a dental student and driven him to get involved in further research projects. His focus so far has been on restorative techniques and dental materials. He has been part of publications in the esteemed Journal of Dental Materials and International Journal of Esthetic Dentistry and currently continues to work on more projects during his final year of study at USC.

What has been the most exciting thing for you through dental school?

Going from spending over a year on some research projects and making discoveries through them, to getting to apply them to my clinical cases has been one of the most satisfying experiences at school. It is hard to explain how enjoyable it is to be mentored by and work with Dr. [Pascal] Magne. He has taught me that when you are truly passionate about a profession, the desire to improve your knowledge and skills never ends. To me, research has been the best bridge to educating myself in the field of biomimetic dentistry. I believe that becoming an excellent clinician requires not only passion and practice, but also research and teaching. The joy that comes with teaching for me goes hand in hand with my love for research and discovery. I feel so honored for being given many opportunities to lecture for dentists and students so far; experiencing this early on has been very exciting for me and makes me look forward to many more in the future.

What drew you to research?

After receiving my bachelor's degree, I decided to spend a year at David Geffen School of Medicine of UCLA, doing just research. I had joined an incredible research team during my undergraduate years, working on multiple projects in the field of neurosurgery; I enjoyed working with this team so much that staying an extra year was an easy decision. After starting my career at USC, I spent hours reading articles that support the biomimetic protocols after being introduced to it by Dr. Pascal Magne in our morphology class. It was then when I realized the importance of research and teaching as part of becoming a good clinician. This realization and my previous exposure to research pushed me to seek for opportunities. I had the pleasure of joining Dr. Magne's research laboratory toward the end of my first year at dental school. It was a dream come true. Since then, I have spent most of my afternoons and weekends working on research projects, alongside excellent visiting scholars from different parts of the world. The more I worked the more my passion for dental research grew.

Can you tell us about your current research projects?

Most of our recent projects revolve around adhesive dentistry. Introducing clinical techniques to decrease the interlayer gaps in composite restorations and im-

Mehrdad Razaghy DDS '19

Improvements in dentin bonding have been my focus during this past year. In one of our most recent publications, we discovered a direct restorative technique that allowed us reach the fatigue resistance and overall quality of indirect restorations when treating large MOD posterior restorations. We incorporated a fiber reinforced composite material as dentin replacement and for the first time we were able to match the quality of indirect or CAD/CAM approach. To have this work published in the Journal of Dental Materials was very exciting for me. Eventually, I was invited to present this work at the USC Eleventh International Restorative Dentistry Symposium. I felt so honored to be the first student who has ever lectured at this annual event.



What are some of the clinical implications of the research you have recently conducted?

What I love about most of the projects that we do in Dr. Magne's lab is the fact that they could be immediately applied in clinic. For instance, we tend to use polarized photography to measure the L.A.B. values, which is a very accurate measure of the color, of samples that go through different types of restorative techniques. This can simply give us a map of color stability or change. This alone becomes an additional and valuable finding to many of the studies that we do. One of our recent publications evaluated the seating accuracy of inlays, onlays, and overlays when luted with pre-heated composite vs. dual-cure cement. Using pre-heated composite as a luting agent is still very controversial for many dentists. In this study we found that not only does heated composite not prevent seating accuracy, but dual-cure luting agents can cause higher seating of inlays. In another study I mentioned already, we introduced a direct technique, by incorporation of fiber reinforced composite as dentin replacement, that allowed us to match the fatigue resistance and overall quality of indirect restorations when dealing with large MOD defects. This is something that can be applied in the clinic the day after, and this is the most satisfying part of research for me.

Upon graduation where do you want to take your career?

I would like to work as a general practitioner and grow myself in the world of restorative and adhesive dentistry. There is still a lot that I need to learn from working outside of a school setting. My goal is to work very hard and create clinical cases that can become great teaching tools. Teaching and giving lectures has become a recent obsession for me; what would all these projects and findings mean if we don't teach and share them? I really look forward to the future and hope to be able to make my incredible mentor, Dr. Pascal Magne, proud.

Photo Courtesy Mehrdad Razaghy DDS 2019

Understanding Skeletal Development and Disease

Simon Youn and Connor Yim



Dr. Amy Merrill is an Associate Professor at the Herman Ostrow School of Dentistry and Keck School of Medicine of USC, with a laboratory at the Center for Craniofacial Molecular Biology (CCMB) on USC's Health Sciences Campus. Dr. Merrill directs a research program focused on understanding craniofacial birth defects and also teaches Problem Based Learning to dental students and Research Methodologies to postgraduate dental students. Growing up, Dr. Merrill always had an innate curiosity for science and medicine, as her father was a cardiologist and her grandfather was an oral surgeon. However, it was her developmental biology and genetics classes at University of California, Santa Barbara (UCSB) that sparked her journey into research. She was incredibly fascinated with how humans start off as a fertilized egg and develop into complex systems where all different cell and tissue types work together to support life. In the beginning, she started at the low end of the totem pole in a *Drosophila* genetics lab making fly food and logging many hours at the microscope screening fly mutants. Although at times tedious, this work introduced her to the idea that a very small genetic change can profoundly alter the process of development.

After graduating from UCSB, Dr. Merrill further pursued her career in earnest by completing her Ph.D. in Biochemistry and Molecular Biology at USC. During that time, she studied under Dr. Robert Maxson, who is one of the leading experts in craniofacial development and craniosynostosis, a birth defect where the skull bones fuse prematurely. She was drawn by the applicability of his research to human disease, and set out to study why craniosynostosis occurs in the genetic disorder known as Saethre-Chotzen Syndrome. Using a genetic mouse model for this disorder, she discovered that premature fusion of the skull bones is caused by disruption of a molecular fence that normally keeps the cells of neighboring skull bones separated during craniofacial development.

After earning her Ph.D., Dr. Merrill completed a post-doctoral fellowship in the Department of Orthopaedic Surgery at the University of California, San Francisco. There she studied neural crest cells (NCCs), which are the precursors of many craniofacial bones. By transplanting NCCs between duck and quail embryos, which develop along different timetables, she showed that donor NCCs not only retain their species-specific information for bone patterning, but also maintain the internal clock that determines the timing of their differentiation into bone cells. The most important concept she learned from her studies was that changes in the timing of skeletal progenitor cell differentiation can alter the shape of the craniofacial bones.

Because Dr. Merrill had a strong desire to apply her expertise in developmental biology to the direct study of human disease, she completed a second post-doctoral fellowship in Medical Genetics at Cedars Sinai Medical Center/University of California, Los Angeles. Training under her mentors, Drs. Deborah Krakow and Dan Cohn, she gained a clinical perspective on skeletal disorders. This work was extremely rewarding and almost addicting for Dr. Merrill. The idea that her research was identifying gene mutations responsible for skeletal disorders and providing molecular diagnoses for patients was highly motivating for her. Dr. Merrill's work identified the disease-causing gene mutation for Short-rib Polydactyly Syndrome, a lethal skeletal disorder that causes babies to suffocate due to skeletal deformities in the ribcage. One of the families participating in the study had 3 of their 4 children die from the disease. By identifying the disease mutation for Short-rib Polydactyly Syndrome, her research pioneered a preimplantation genetic diagnosis test that this family then used to subse-

quently birth a healthy child. It is Dr. Merrill's desire to help families like these that keeps her working late at night and gets her up early in the morning.

In 2010, she was offered a position as an Assistant Professor at USC, and there was never a doubt in her mind about whether or not she should come back. She has always loved the collegial and collaborative environment at USC and believed it was the best place to start her independent research program. Currently, her lab is studying genetic disorders that affect the skeleton, and in particular, they are focused on those that affect the craniofacial skeleton. Their goal is to understand the mechanisms underlying such diseases and in the process, gain a fundamental understanding of normal skeletal development. By studying rare skeletal birth defects, their research is revealing new information about cell fate choice in skeletal progenitor cells and integrated development of tendon and bone. Her thought process is that if we know a gene mutation leads to a skeletal difference, then we can assume that the gene is important to the process of skeletal development. Her approach is to model the diseases using patient-specific cells and mouse genetics.

One particular disorder Dr. Merrill's lab is focused on is Bent Bone Dysplasia Syndrome (BBDS), a lethal skeletal disorder she discovered with Dr. Krakow. From naming and clinically describing the disorder, to identifying its disease-causing mutations, to understanding the molecular consequences of the disease mutation, and now modeling in the disease in mice, her research on BBDS is comprehensive. The craniofacial aspect of this disorder, which includes craniosynostosis, is very severe. She hopes that her research will come full circle to reveal therapeutic options for families faced with a BBDS diagnosis, or for others who are suffering from related disorders. Dr. Merrill, as the leading expert in BBDS, is compelled to continue to study this disorder even though it is very rare. In the end, she believes that it is all about trying to make a difference, even if it's in one person or one family.

Dr. Merrill was promoted to Associate Professor with tenure in Spring 2018. She attributes her success to fantastic mentors, a talented research team, and plain old hard work. She said that the key to overcoming the challenges in science is to follow research you are passionate about and find dedicated mentors who will help you cultivate your scientific voice. Currently, the biggest challenge she faces is finding a balance between her work and family life. She has two children and believes that being a mother has made her a better scientist because it required her to become extremely efficient and goal-oriented.

In the future, Dr. Merrill hopes to expand her research program and grow her "scientific family." She is passionate about training the next generation of scientists and wants to continue to encourage those interested in pursuing a career in science. She believes that success is determined by initiative, hard work, passion, and willingness to pick yourself off the ground in the face of failure. Dr. Merrill's strong work ethics, passion for science, and compassion for those children with rare facial differences and their families have made her the scientist she is today. She has already accomplished so much, and we are excited to see her future accomplishments her at USC.



Photo Courtesy Dr. Amy Merrill Laboratory



THE ROLE OF PROTEIN DEAMIDATION IN VIRAL INFECTIONS & TUMORGENESIS

TERESA NGUYEN

Dr. Jun Zhao is a Post-doctoral Research Associate in the Department of Molecular Microbiology and Immunology at the Keck School of Medicine of USC. He has been deeply invested in research for many years, since his involvement during his undergraduate career. Dr. Zhao's educational journey began in Shanghai, China where he earned his Bachelor's Degree in Biological Sciences at Fudan University. His research focus at that time revolved around microbiology, from both biosynthetic and biomedical approaches. During this time, Dr. Zhao worked on genetically engineering thermophilic bacteria in order to produce a recombinant strain capable of alcohol production. In addition, he investigated the role of novel ubiquitin-activating enzymes during DNA damage and repair. With an interest in becoming a principal investigator and further immersing himself into the field of interdisciplinary research, Dr. Zhao made the leap and moved to the United States to pursue his education at USC. He earned his Ph.D. in Genetics, Molecular, and Cellular Biology at the Keck School of Medicine of USC. Since then, he has continued his post-graduate training with Dr. Pinghui Feng, who is the Section Chair of Infection and Immunity at the Herman Ostrow School of Dentistry of USC.

Much of Dr. Zhao's work revolves around interactions between the herpesviruses and host innate immune responses during infection and pathogenesis. One strand of Dr. Zhao's research is geared towards the herpes simplex virus 1 (HSV-1); his team studied how the innate immune system antagonizes viral replication through the activation of a pattern recognition receptor. By manipulating this key pattern recognition receptor, the virus is able to evade detection during an innate immune response. UL37, a protein deamidase of HSV-1, interacts with retinoic acid-induced gene I (RIG-I), which is a cellular receptor that recognizes pathogenic RNA. Activation of RIG-I is crucial to the host's innate immune defense response as it recognizes double-stranded DNA produced by HSV-1 infection to trigger antiviral cytokine production. By deamidating RIG-I, the herpesvirus is able to block RNA-induced RIG-I signaling transduction, which ultimately results in an impaired antiviral immune response. This project on HSV-1 provides a foundation for understanding the fundamental role of protein deamidation in regulating innate immunity during viral infection. By studying virus-host interaction, Dr. Zhao aims to expand our capability to develop anti-viral drugs that intervene in virus-host

interactions such as the activation of pattern recognition receptors in order to restore optimal antiviral immune responses to fight against the herpes simplex virus.

Branching beyond the investigation of viral-host interactions, another area of Zhao's research interest investigates the role of protein deamidation in fundamental cellular processes. Specifically, his research aims to examine the roles of pro-inflammatory transcription factor deamidation in reprogramming metabolism and promoting proliferation. Zhao discovered that this basic mechanism is tightly associated with tumorigenesis of a number of cancers despite their different origins. Moreover, it is highly likely that oncogenic viruses exploit such deamidation to enable viral survival and tumorigenesis. Kaposi sarcoma-associated herpesvirus (KSHV) is the etiological agent of Kaposi's sarcoma in immunocompromised patients, specifically HIV and organ transplant patients. The oral cavity is the most common site of Kaposi's sarcoma lesions; moreover, oral Kaposi's sarcoma displays a significantly higher viral load and poorer prognosis than other forms of the disease. Proteins involved with the development of tumor growth include NF- κ B transcription factors.

Rel or NF- κ B proteins are involved in cell growth, apoptosis, and immune responses. When the RelA subunit of an NF- κ B transcription factor is deamidated, tumorigenesis and cell division are enhanced. Dr. Zhao is currently incorporating interdisciplinary approaches of virology, cell biology, and biochemistry to investigate the potential role of this protein deamidation in regulating cellular metabolism and its role in proliferation and KSHV-associated oncogenesis in the oral cavity.

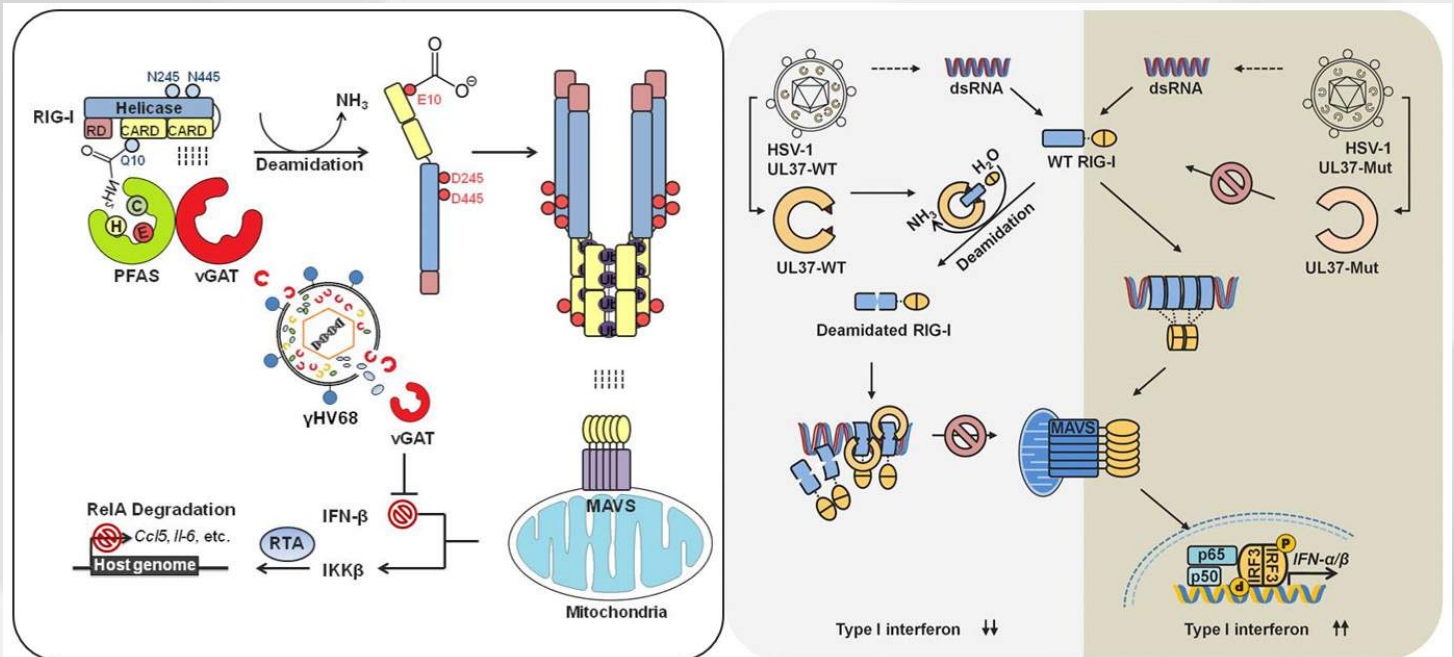
□...therapeutic interventions can be discovered and engineered to treat and prevent oral diseases. □

Graphic Courtesy of Dr. Jun Zhao

Unbeknownst to many, Dr. Zhao has a strong interest in engineering. His passion stems from his research experience on engineered thermophilic bacteria for alcohol production back in college. From those attempts, he firmly believes that before you can build a new system, you must understand the basics. Ultimately, Dr. Zhao hopes to engineer viral vectors to serve as anti-viral drugs. Based on the structure of HIV-1 glycoprotein, he has been working on the development of antibody-mimetic ligands as novel HIV-1 neutralizing reagents via protein engineering. Dr. Zhao believes that by understanding virus-host interactions, we could generate attenuated viral strains carrying specific mutations that result in their inability to evade specific immune responses and manipulate host cells. Going back to the role of RIG-I during HSV-1 infection, Dr. Zhao mentions that by engineering a deamidation-resistant RIG-I or introducing a deamidase-deficient UL37 into the HSV-1 genome, we can uncouple RIG-I deamidation from HSV-1 infection. This uncoupling will help to restore antiviral

immune response. Consequently, these viral strains could serve as excellent candidates for viral vaccination or oncolytic cancer therapy. Through biochemistry, viral vector and protein engineering, Dr. Zhao hopes to apply engineering principles and design concepts to translate basic findings into clinical applications.

As of Fall 2018, Dr. Zhao and his mentor, Dr. Feng, joined the Ostrow research community. With his immense knowledge in the fields of virology and innate immunity, Dr. Zhao plans on expanding his research to focus on interactions between oral pathology and innate immunity to further investigate oral diseases such as oral Kaposi's sarcoma. In addition, Dr. Zhao is also studying how infection with herpesviruses plays a role in other oral infections and tumorigenesis. Ultimately, he hopes that by utilizing our understanding of how the host immune system responds to oral infections and the evasion strategies from the pathogens, therapeutic interventions can be discovered and engineered to treat and prevent oral diseases.



ORAL RADIOGRAPHY: LEADING THE TRANSFORMATION FROM *Clinician* to a *Diagnostician*

AZZAH WIDATALLA

*R*adiographic examinations of the oral cavity serves an essential role in the diagnosis and management of dental pathologies. At the Herman Ostrow School of Dentistry of USC, students are not only taught how to capture and interpret dental radiographs, but also how to keep up with the ever-changing technological advances in oral radiology. This ensures students learn how to deliver the safest radiographs for their patients. Through the notable efforts of Dr. Elham Radan, the Director of the Radiology Clinic, students graduate as skilled clinicians, able to both diagnose and treat effectively and efficiently.

Born and raised in Tehran, Iran, Dr. Elham Radan was the first in her family to pursue a career in dentistry. As a child, Dr. Radan was always interested drawing, highlighting her creative nature. With an excellent overall standing as a student, sharp attention to detail, and interest in the visual arts, Dr. Radan had all the qualities that would enable her to thrive in any career. Through the encouragement of her parents, Dr. Radan found that dentistry incorporated both her passion for the sciences and her talents in the arts. Little did Dr. Radan know that her dual interests would eventually lead her to direct the Radiology Department at the Herman Ostrow School of Dentistry of USC.

After receiving her doctoral degree in dental surgery from Shahid Beheshti University in Tehran, Dr. Radan furthered her dental education by

pursuing her master's degree in oral radiology at the University of British Columbia. There, under her mentor Dr. Colin Price, she discovered her passion for diagnostic imaging. She loved the ability to interact with patients as a clinician, and also to work individually as a diagnostician, studying radiographs to reveal different pathologies of the oral cavity. She believes that the most challenging part of treating a patient is the diagnosis. Therefore, if there are diagnostic tools that exist to aid this process, those tools are invaluable to the practicing clinician.

Upon completing her master's degree, Dr. Radan worked as a teaching assistant, then shortly thereafter became part of the faculty at the University of British Columbia. She attributes her interest in teaching to her days in high school. As a teenager, Dr. Radan was very skilled at explaining to her friends difficult concepts that were taught in the classroom. She remembers a time when she would teach her classmates mathematics, and found a sense of fulfillment in seeing their sense of confusion transform to a state of understanding.

Furthering her interest in education, Dr. Radan moved to the Los Angeles to work as a part-time faculty member at the Oral Radiology Department at UCLA. She found this job very fulfilling because it allowed to her to maintain a career and still have time to raise her children. In 2012, Dr. Radan started her career at the University of Southern California as the Director of the Oral Radiology De-

partment, where she not only taught, but also designed and constructed, the radiology curriculum for all students, including the DDS, Advanced Standing Program for International Dentists (ASPID), and dental hygiene programs.

Dr. Radan enjoys being able to find different ways of teaching oral radiology. Knowing that students do not all learn in the same manner, she makes sure to offer a variety of teaching styles to ensure her courses are effective. From group learning exercises to video lectures, and from at-home research activities to in-person interactive lessons, she is able to keep her students engaged.

On top of designing the curriculum, Dr. Radan consistently ensures the clinic is up to date with radiological advancements. By implementing the use of rectangular collimation instead of round collimation, Dr. Radan was able to effectively lower patient radiation exposure up to 60%. Transitioning the clinic from using film to digital radiography allowed for improved image quality and visibility of anatomical structures. It also allowed students and assistants to efficiently take radiographs of patients without the hassle of having to develop film, thus allowing more time to learn other practical skills in the clinic.

Dr. Radan first began her research endeavors in 2002 by publishing the "Evaluation of digital and geometric unsharpness in dental radiographs using an endodontic file mode" in the peer-reviewed journal Oral Surgery,

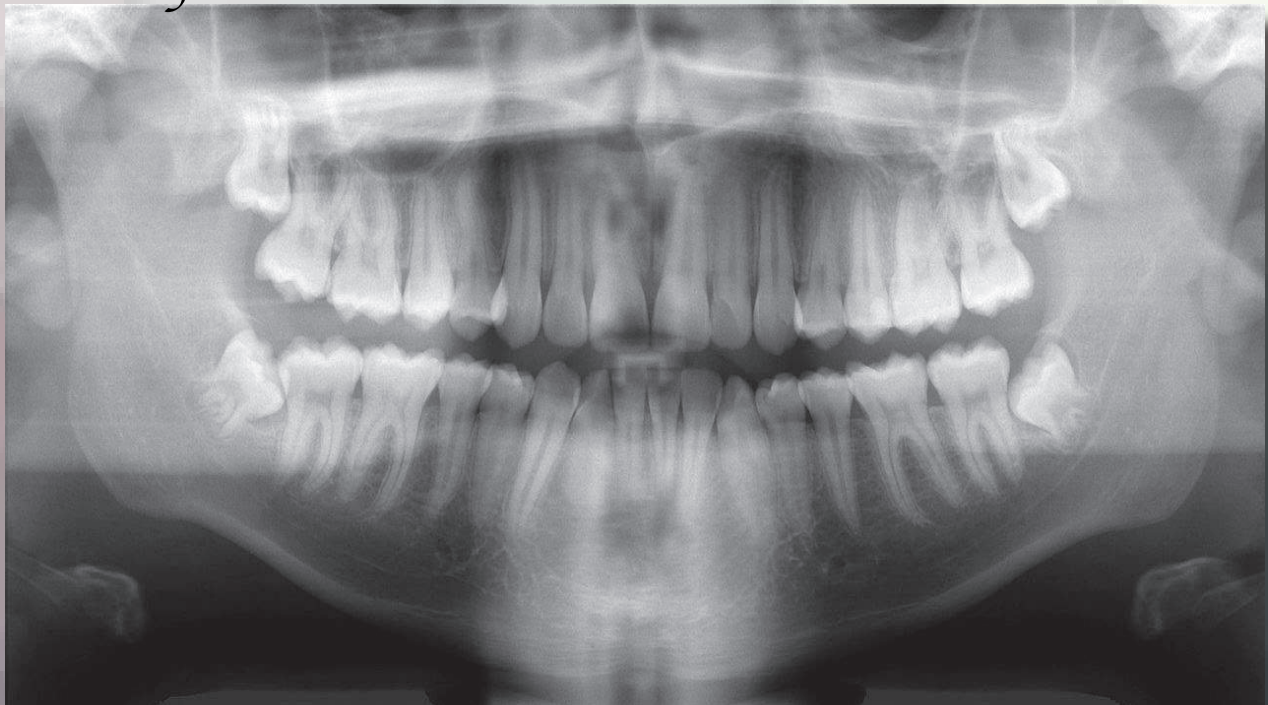
Oral Medicine, Oral Pathology, and Oral Radiology. The research explored whether or not increasing magnification or resolution of files would provide any relevant advantage in dental radiography. This is significant because at the time, data storage space was quite limited, so dentists were not able to optimize their data. Through this research, it was concluded that there was little to be gained from larger file sizes, so clinicians were able to use smaller file sizes yet retain the same diagnostic abilities.

In 2017, Dr. Radan published “Lowering the radiation dose in dental offices” in the Journal of the California Dental Association. As each generation redefines what health and wellness mean to them, it also comes along with a thirst for information. Radiation exposure has become a particular topic of interest recently, and as Dr. Radan has noticed the growing anxiety patients feel in this regard, she is redefining exposure parameters in the dental space to ensure patients are receiving radiation doses that align with the ALARA principle - As Low As Reasonably Achievable. With the introduction of more advanced modalities such as 3-D cone beam computed tomography, the dental clinician is now able to reduce patients’ exposure to a minimum.



Dr. Radan wants her students to graduate not only as clinicians but also as diagnosticians. She hopes for them to leave the Herman Ostrow School of Dentistry with the ability to diagnose confidently and with the tools to enable them to answer their questions by researching. In the future, she aspires to incorporate more advanced modalities into the curriculum, and to ensure students see the importance of staying up to date with the frequent changes in oral radiology. By incorporating research into her teaching, accompanied by different learning techniques, Dr. Radan is able to effectively instill qualities she believes will allow her students to become skillful dentists.

Dr. Radan found that dentistry incorporated both her passion for the sciences and her talents in the arts.



THE SCIENCE BEHIND CURING LIGHTS & COMPOSITE MATERIALS

Sara Kahng

Growing up in her home country of Croatia, Dr. Alena Knezevic fondly recalls wanting to be a teacher at an early age. Upon pursuing dentistry, Dr. Knezevic found an opportunity to teach others while providing care to her patients as well. After receiving her DMD at the School of Dental Medicine at the University of Zagreb in Croatia, Dr. Knezevic pursued both her Master's degree and PhD in Biomedical Sciences. During that time, Dr. Knezevic actively researched composite materials and curing light units and became an erudite scholar of restorative dentistry. She was invited to continue her research at the University of California, Los Angeles and the University of Southern California, where she furthered her expertise and dedicated her time as a Teaching Assistant in preclinical restorative and CAD/CAM dentistry courses. Dr. Knezevic is currently a Clinical Assistant Professor in the Department of Restorative Sciences at the Herman Ostrow School of Dentistry of USC, where she continues to share her immense knowledge of restorative dentistry with her students.

Dr. Knezevic's most cited research studied the use of blue light emitting diodes (LED) for photopolymerization of dental materials. While much of restorative dentistry is often focused on the composite material itself, the study and understanding of curing light units is essential for ensuring optimal polymerization of composite resin material. Proper polymerization requires sufficient radiant intensity, correct wavelengths of visible light, and an appropriate curing time. Previously, halogen curing units with 450-470 nm wavelengths were commonly used in the clinical setting for polymerization of composite. However, the development of blue superbright LED with a 470 nm wavelength provided an alternative to the halogen curing units. Dr. Knezevic's re-

search compared the degree of conversion (DC) and temperature rise between the traditional halogen curing units and the new blue superbright LED. Results showed that while the DC values were higher for halogen curing units compared to blue LEDs, the difference was negligible due to the low curing intensity of the newer units. However, the blue LED's low curing energy allowed for slower polymerization of the composite material, ultimately resulting in a smaller temperature increase. Less temperature increase is favorable, as heat from composite polymerization can lead to pulp inflammation and jeopardize pulp vitality. Dr. Knezevic's findings thus confirmed the superiority of blue LEDs for composite polymerization in preserving pulpal health over halogen curing units.

Dr. Knezevic continues to expand upon her previous research and how it applies to the current third generation of curing lights. The third generation incorporates both blue and violet curing lights. The blue light cures composite with camphorquinone photoinitiators; however, the camphorquinone photoinitiator is an undesirable yellow color when not cured properly. Dr. Knezevic explains that as a result of the increased demand for different enamel shades, manufacturers introduced more translucent and bleaching shades to better resemble enamel. These materials incorporate a different photoinitiator with a lower activation wavelength and therefore require violet light to cure. In the classroom, Dr. Knezevic underscores the clinical implications and proper application of these units, as manufacturers often do not explain these aspects of their products in detail. When asked about the significance of the violet and blue lights, Dr. Knezevic elucidated that the violet and blue diode chips are not evenly distributed

within the curing bulbs, and as a result, curing a molar on the right and left will result in an unequal cure. For example, transferring the curing unit with a violet light on the buccal side and a blue light on the lingual side of the right molar results in the opposite pattern on the left molar. As a result, the restoration will not cure evenly. In order to ensure even composite polymerization, Dr. Knezevic recommends rotating the curing light after every 20-second curing interval.

With the increased accessibility of non-certified curing units that are available on markets such as Amazon, Dr. Knezevic emphasizes the importance of understanding the proper use of curing lights. She explains, "With halogen light curing units... the halogen bulb needs to be replaced because it only lasts 50 hours. With LED they can last longer, but they can still decrease in intensity during that time. So that's why you need to check the intensity of your light units every semester. The second problem is if you have cordless [curing lights]. So for those, intensity, while the battery goes off, can either slowly decrease or it can stay the same. It's the same with the cell phone. The more you use it, the shorter the battery lifetime. So then you need to charge it all the time... If you purchase the units over the counter, you don't know how long the battery can last. And you don't know if with decreasing battery power there is decreasing blue light intensity." Without proper understanding and usage of curing lights, the integrity of a restoration is compromised.

When asked about the direction of future research on composite materials and light curing units, Dr. Knezevic delves into the topic of bulk composite. With the ever-evolving market of composite materials, manufacturers have developed bulk composite that can be placed in four- to five-millimeter increments, compared to the typical composite in-



Dr. Alena Knezevic

crements of two millimeters. However, Dr. Knezevic hesitates to support this claim as most of the current research recommends no more than four millimeter increments. Dr. Knezevic adds that traditional composites cannot be light-cured in more than two-millimeter increments because the violet light cannot penetrate more than two millimeters. In order to overcome this constraint, manufacturers include additional photoinitiators and alter the ratio of components in a composite in order to achieve adequate light-curing in bulk. Although the manufacturers claim that the bulk composites shrink less than traditional components, research shows that bulk composites continue to shrink. However, more importantly, Dr. Knezevic explains that the increased mass of bulk composite results in an excess of exothermic heat. The resulting temperature increase speeds up polymerization and slows the setting of the material.

Dr. Knezevic is a passionate researcher and educator who strives to teach her students to be informed and skilled clinicians. While research on composite materials and curing lights may seem esoteric at times, Dr. Knezevic hopes to make that knowledge accessible and useful for her students. Her enthusiasm for teaching is reflected in her interactions with her dental students as she patiently guides them on the clinic floor. As an English teacher for Croatian elementary students during her spare time, Dr. Knezevic jokes, “I see them [dental students] as the same as the first graders...you have to repeat everything 100 times... But at the end...I’m happy to see how much you improved.” Dr. Knezevic’s dedication and commitment to her students and the dental community make her an irreplaceable part of our faculty at the Herman Ostrow School of Dentistry.

References

Knežević, A., Tarle, Z., Meniga, A., Šutalo, J., Pichler, G., & Ristić, M. (2001). Degree of conversion and temperature rise during polymerization of composite resin samples with blue diodes. *Journal of Oral Rehabilitation*, 28 6, 586-91.

Photo Courtesy of John Skalicky

A Resolution for Dental Public Health

Nirav Patel & Rajdeep Batth

“These are people who are physically, emotionally, socially and financially disadvantaged. By restoring their smiles, we tend to help them put their lives back on track. A healthy smile goes a long way in restoring their self-confidence and instilling a new hope in them. Sometimes, I just sit with them and make them feel listened to, and that does the trick. Mutual trust and respect are the key here. This is what I teach my students. At the ‘clinic’, we make every possible effort to address one of the most fundamental human needs of the most vulnerable sections of our society.”

This is how Dr. Mehdi Mohammadi describes the impact of USC’s community clinics on Skid Row in downtown Los Angeles. Dr. Mehdi is the Clinical Director at the John Wesley Community Health Center. He is also an Assistant Professor of Clinical Dentistry at the Herman Ostrow School of Dentistry of USC and the Section Chair for Community Adult Care.

Los Angeles has a larger homeless population than any other city in the United States. Skid Row is a 50-block area in downtown LA where almost 2,000 homeless individuals reside. Access to oral healthcare is a distant dream for many of these people and, obviously, is not always a primary concern for them. A lot of these individuals have problems such as substance use or mental health issues that further aggravate their overall health. Sometimes, all they need is a little nudge to help them stand back up on their feet. With the aim of providing comprehensive oral health care to this population, USC operates two dental clinics in this area.

Union Rescue Mission (URM) is an eight-chair dental clinic that opened its doors in 2000. However, owing to the huge demand for affordable dental care, a similar clinic was opened across the street in 2010. This second clinic, equipped with 7 chairs, is called the John Wesley Community Health (JWCH) Center. Dr. Mehdi started as a volunteer and later worked as a part-time faculty

member at the URM for a couple of months, before he was offered a position to become the Clinic Director at the JWCH Center in 2013. In his own words, “it has been an eye-opener for me to see how many people do not have access to oral care, [even] in a rich country like the United States and especially Los Angeles.” His experience of working with the students to provide oral healthcare to underserved population so far has been very rewarding.

The services provided at these clinics consist of prophylaxis, extractions, restorative fillings, root canal therapy, and fabrication of partial and complete dentures. All the services provided are free and delivered by Ostrow dentistry and dental hygiene students, under the supervision of expert faculty. The clinics initially operated one day a week, but due to high demand currently operate six days a week.

After working for almost two years at the clinic, Dr. Mehdi felt a need to expand his knowledge. In order

to better understand the complex healthcare needs of medically compromised individuals, he enrolled in a three-year Master's of Geriatric Dentistry program at USC in 2015. This program gave him strong motivation to engage in research that will ultimately lead to improved care for geriatric patients. His current research project includes a study called "Efficacy of saliva substitutes and stimulants in the treatment of dry mouth."

Elderly people mostly suffer from dryness of mouth (xerostomia) as a side-effect of certain medications. This condition affects their quality of life and overall health, which could be improved using non-pharmacological methods. Along with a colleague, Dr. Mehdi reviewed evidence related to saliva substitutes to address xerostomia. This study, which is in the final stages now, used only randomized controlled trials using placebo interventions with dry mouth patients. Another research project he has recently begun involves calculating the decayed missing filled surface (DMFS) index of the local homeless population. The DMFS index can be used to assess the overall burden of oral health problems in a particular group of people and could subsequently be used to design programs and services to address the specific oral care needs of the population.

In addition to his work at the JWCH Center, Dr. Mehdi is the faculty advisor to the Smile Project at USC and is involved in a number of community-based projects. His interest in community dentistry developed when he was pursuing his dental degree in a small town in the southern

part of India called Belgaum. As part of his rotations, saw a lot of patients who could not even afford more than one meal a day, let alone access to healthcare. He actively participated in community outreach by volunteering with a mobile dentistry van. He was amazed that performing some simple dental procedures or just providing oral hygiene instructions could make a huge difference in the oral health of these people.

As a faculty advisor to the student chapter of the American Association of Public Health Dentistry (AAPHD), Dr. Mehdi is a strong advocate for dental public health. He always places great emphasis on the importance of public health dentistry. This was one of the reasons he chose a career path in dentistry in the first place, so he could make an impact at the population level. He advises all budding dentists to choose commu-

nity dentistry as their career path or participate in community projects as much as their schedules allow. This provides an opportunity to experience the positive aspects of community practice as well as professional philanthropy.

Dr. Mehdi enjoys the academic and leadership aspects of his current positions at the Ostrow School as well as the JWCH Center. He was recently appointed as the Section Chair for Community Adult Care. His current work week consists of working four days at JWCH center and one day at a private dental office. He enjoys listening to music and spending quality time with his 6-year old daughter. When asked what he would have done differently if given the option of doing over, he answers, "never regret your past; do not worry about your future; live in the moment."



Dr. Mehdi

Caring for the Pediatric Community

Ana Zapata Caceres & Chenxin Li

Dr. Camille Nishikawa is the director of the QueensCare + USC Mobile Dental Program. Growing up in Los Angeles, where she was born, she maintained community health as a central piece of her career goals. She graduated from the University of California, Los Angeles in 2006 with a Bachelor of Science and went on to pursue her passion for dentistry. She graduated from the University of Southern California's Doctor of Dental Surgery (DDS) program in 2010. During her time in dental school, Dr. Nishikawa spent most of her free time volunteering with AYUDA and the Children's Dental Clinic in Inglewood. She found that she really enjoyed working with children and, guided by the advice from her mentors, she decided to embark on a new journey into the field of pediatric dentistry. She completed a pediatric residency in MetroHealth Medical Center in Cleveland Ohio in 2012. Her passion for community health continued during her residency as she established screening programs using trailers that were not being utilized. She then returned to the Herman Ostrow School of Dentistry of USC to serve as Co-Director of the QueensCare + USC Mobile Dental Program. A year later, Dr. Nishikawa became the Director.

Herman Ostrow School of Dentistry of USC is tremendously involved in the pediatric community and pediatric community health. As the chair of the pediatric community programs, Dr. Nishikawa takes great pride in her work, which keeps her rooted and is the reason she went



into pediatric dentistry in the first place. There are three major pediatric community health programs at the Herman Ostrow School of Dentistry of USC, each of which serves a different community: the QueensCare + USC Mobile Dental Program, the USC Mobile Clinic, and the USC Neighborhood Mobile Dental Van Prevention Program.

QueensCare + USC Mobile Dental Program is a partnership between LAC+USC, Herman Ostrow School of Dentistry of USC, and QueensCare. QueensCare + USC Mobile Dental Program was established in 2001 as a response to the Los Angeles Unified School District's affirmation that dental pain is the number one reason children miss school and that more than 50,000 children miss school due to dental-related reasons. QueensCare + USC Mobile Dental Program runs for three months and at two different locations simultane-

ously all year long. For those three months, the services are set up directly on elementary school grounds work around the school schedules. This program provides dental care for children eighteen and under who within the LAC+USC area; publicity and media attract children from other areas, but the location of the clinics themselves is limited to the LAC+USC region. Any child under the age of 18 is eligible to receive free comprehensive dental care, including services that range from dental exams to dental fillings. No questions are asked (other than medical history, of course). If for some reason procedures cannot be completed at the clinic, QueensCare provides patients with grants to complete their treatment plan at the Pediatric Clinic at the Herman Ostrow School of Dentistry. Last year, QueensCare + USC Mobile Dental Program treated more than 2,000 patients and completed over

15,000 procedures. At the moment, one of Dr. Nishikawa's biggest recent accomplishments is getting a new state-of-the-art trailer that is currently the largest trailer in square footage in the nation. QueensCare + USC Mobile Dental Program has a total of three trailers, one with six chairs and the other two with three chairs each. Presently, third- and fourth-year dental students, Advanced Standing Program for International Dentists (ASPID), and second-year dental hygiene students have one-week rotations at the QueensCare + USC Mobile Dental Program. Despite this high volume in student traffic, student volunteers are welcomed.

The USC Mobile Clinic is an initiative undertaken by USC to improve pediatric community health. This program is completely run and operated by USC and it is a required rotation for all DDS candidates. The USC Mobile Clinic focuses on the pediatric population, but adults may also be evaluated and treated depending on the needs of the community. This program has provided the equivalent of over \$50,000 of free comprehensive dental care. It runs once a month for a week to a week and a half. Approximately 1,900 dental procedures are completed

per clinic and 900-1,100 patients are seen for comprehensive dental care. The program opens nine to ten times each year and moves throughout Southern and Central California. Currently, the USC Mobile Clinic has four trailers; one is a sterilizer and the other three are used to treat patients.

The third community oral health program is the USC Neighborhood Mobile Dental Van Prevention Program (NMDVPP). This program is part of the USC Good Neighbors Campaign. It provides free dental care to children attending USC-partnered schools. Dental hygiene students rotate through this program to provide oral health instructions, screenings, fluoride treatments and dental sealants. The program is housed in two trailers, which are also used at numerous health fairs, such as the Tooth Fairy Convention, the Telemundo Health Fair, and the Los Angeles Times Festival of Books. During the 2017-2018 academic year, the USC NMDVPP provided 118 patients with in-depth preventive dental treatment which included oral exams, prophylaxis, fluoride varnish applications, nutritional guidance, and oral health education/instructions. A total of 186 individual sealants were placed on

55 patients who warranted sealant treatment. The Oral Health Education Program (OHEP) provided 630 children with oral health instructions and the Anti-Tobacco Education Program (ATEP) provided 1,170 individuals with anti-tobacco education. Both of these programs are affiliated with the USC NMDVPP. In other NMDVPP signature outreach events, like the Great American Smoke-out, USC Family Weekend, and the L.A. Mayor's Halloween outreach event, 826 individuals received screenings and oral health education. During the health fairs, a total of 1,906 individuals obtained dental screenings, oral health care instructions, and nutritional guidance. In sum, a total of 4,947 individuals received free dental care and preventive services through the USC Neighborhood Mobile Dental Van Prevention Program in 2017-2018.

These three pediatric community programs directly involve dental hygiene and dental students and are experiences that every dental hygiene and dental student receives during their time at the Herman Ostrow School of Dentistry of USC. As the chair of the pediatric community programs, Dr. Nishikawa's goals are to increase and streamline communication between these three invaluable programs as well as to identify the areas and populations still in need of dental care. She works relentlessly to maximize the services that these programs provide, and consequently to improve dental care for Los Angeles's pediatric community. Her work carries forward USC's banner in community outreach and we feel honored she is a Trojan. Fight on!



RAFAEL ROGES: TEACHING WITH PURPOSE

Nina Bubalo & Nathan Nourian

Dr. Rafael Roges' path to dentistry may seem familiar to some: he grew up in a dental family and admired his father's work from a young age. "My father was one of the most influential people in my life. I always wanted to follow in his footsteps," Roges recalls. He remembers that when he was a young boy, he spent summer vacations in his father's dental office, assisting his father by mixing amalgam. Roges chuckles as he says, "after a long day of working, he would pay me with a churro."

Dr. Roges' journey started in Cuba where he was born. His family was quickly uprooted to Mexico, where his mother had family, to escape the communist regime in hopes of a better life. Dr. Roges and his family lived in Mexico for 10 years where his father worked as a hospital dentist, treating underserved communities by performing basic dental work. He instilled in Roges a sense of duty to the community, to always give back when possible. These lessons would later be reflected in Dr. Roges' own life, as he serves as a esteemed teacher and an education. After their time in Mexico, the family eventually moved to America and put down roots.

Dr. Roges eventually did follow in his father's footsteps. He was accepted into the University of California San Francisco for dental school and later into USC's Advanced Endodontics program, of which he is currently the Chair. Because of this position, Dr. Roges is intimately familiar with the research happenings in the Endodontics Department. Dr. Roges explains, "every endodontics resident has to choose a research project for graduation. Although the program's primary focus is dentistry, research is still an integral part of the learning process."

Residents primarily do two types of studies, namely clinical and retrospective. One recent clinical trial monitored the effect of Acyclovir, an antiviral



drug, on reported root canal pain. Traditionally, root canal pain is caused by bacteria inflaming and irritating the pulp. This study could have a huge impact on the way endodontic pain is treated, as it tests the role of viruses in pain associated with root canal therapy. Another clinical study is looking at the effects on chlorhexidine versus calcium hydroxide as a root canal irrigant. Previous studies have shown that long-term exposure to calcium hydroxide may weaken dentin, while chlorhexidine may improve the quality of long-term resin bonding. This theory is being tested. Yet another study is being conducted to test the importance of patency on root canal therapy. In the past, 50% of dental schools required patency while 50% of dental schools did not. Today, the numbers are closer to 70% requiring patency and 30% not requiring it.

In an interestingly interdisciplinary team, Dr. Roges and his brother, Dr. Ramon Roges, Director of the Emergency Clinic at Ostrow, are researching shock absorbency of mouthguards. Dr. Ramon Roges works closely with the USC football team to provide mouth-

“I am proud to be here. I love my residents”

guards for the players. Currently, they are testing a sandwich technique with different thicknesses of sorbitane to reduce impact force, which is linked to concussions. Dr. Roges makes the mouthguards and the School of Engineering tests the shock absorbance with their machines. Dr. Roges' goal and challenge is to make a mouthguard that is strong enough to withstand the blows on the field but also comfortable enough to ensure wearer compliance. “If they are uncomfortable,” he says, “they won't wear it. You can make the mouthguard withstand a fighter jet, but if they don't wear it, it doesn't matter.”

Dr. Roges is a huge proponent of the use of cone beam computed tomography (CBCT) scans prior to endodontic therapy. “Not only does it show the anatomical complications of a tooth and its surrounding anatomy, but also trauma or fractures the tooth has endured.” Dr. Roges continued by stating that CBCT scans are now a staple when performing endodontic retreatments. “The number one cause of root canal failure is missed anatomy or missed canals,” he notes. With the use of CBCT, endodontists are now able to gain more information about a tooth prior to treatment, and are also able to gain retrospective information about why a failed root canal was not successful. In addition to retreatments, there are many other benefits to using CBCT, such as for locating the position of the mental nerve or the sinus. CBCT is fantastic tool for showing anatomical complications that may arise during treatment, and it can also prove very useful in trauma cases such as root fractures. In standard x-ray images root fractures can look horizontal, whereas in actuality, they can be oblique. In fact, a former advanced endodontics resident is on the brink of publishing a paper using information gathered from over 1,500 CBCT scans. This study charted anatomic changes in the location of the mental foramen based on patient age and ethnicity. Such differences are of clinical importance but have never been documented before. Dr. Roges believes that in the next 10-15 years, CBCT scans will become the standard of care before performing any root canal therapy. “It's like having a GPS in your car--it tells you where everything is. This is a controversial opinion, but I believe it.”

Dr. Roges is incredibly proud of the Advanced Endodontics program and the residents themselves. “I am proud to be here. I love my residents,” he gushes. The feeling, it seems, is mutual, as all the residents dressed up as him for Halloween one year. The program is hugely diverse with residents from all over the world. Some hail from Los Angeles, the greater US, Spain, Japan, San Salvador, Honduras, Saudi Arabia, Syria, and South Africa. The program also has an even male/female ratio.

Dr. Roges has always had a passion for teaching. After completing dental school in 1991, he became a part-time member of the Restorative Sciences faculty at USC, following his brother Ramon Roges, who was already USC faculty. It was through Ramon that Dr. Roges met the second most influential person in his life, Dr. James Simon. Simon became a member of the USC Endodontics faculty in 2000 and quickly formed a bond with Dr. Roges, eventually becoming his mentor and lifelong friend. “He was great mentor,” Dr. Roges explains, “a fountain of knowledge, and I'm very grateful to have know him.” It was through Dr. Simon that Dr. Roges was guided into applying for an endodontics specialty. He was accepted into USC's Endodontic residency and shortly after graduation in 2006, bought a practice while continuing part-time teaching. However, Dr. Simon had other ideas for Dr. Roges in terms of teaching. Dr. Roges realized that Simon “saw in me what I couldn't see in myself, which was being a full time educator.” This commitment to education would eventually pay off as Dr. Roges was appointed to an endowed professorship, one of the highest awards a university can bestow on a faculty member. He was appointed to the Wayne G. and Margaret L. Bemis Professorship in Endodontics in 2015, the endowed professorship formerly held by his mentor, Dr. Simon.

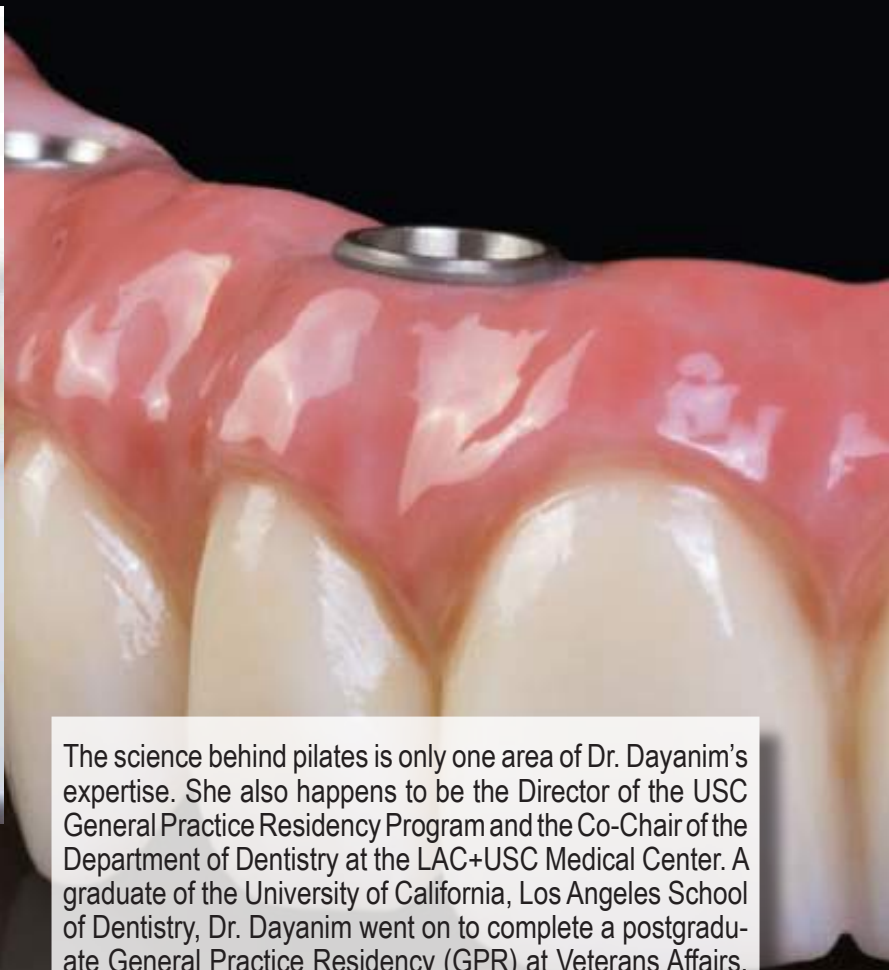
When not teaching, Dr. Roges has many hobbies outside the office. He is a car fanatic and has won several car show awards. He enjoys restoring old cars to their former glory and occasionally works with his best friend, who happens to be a mechanic, to do so. He also enjoys boating and staying active.

ZEN AND THE ART OF GPR PROGRAM MANAGEMENT

Meredith Messerle & Abigail Heleba



"It's really challenging to present something so obscure and something so non-dental related to a bunch of scientists," says Dr. Rebecca Dayanim, referring to her upcoming presentation at the American Dental Education Association Annual Session - Unpacking Back Pain: The Pilates Secret to Dental Practitioner Longevity. Her solution? "You have to bring the science into it." Having suffered back spasms herself, and knowing several friends and colleagues who have left the dental profession due to disability, Dr. Dayanim is dedicated to her weekly pilates sessions. She started practicing pilates in college and earned her teaching certificate in Mat Pilates in 2015. "Pilates really saved my back and I just really believe in what it does. I think that if every dentist did pilates twice a week, they would have such a different life!"



The science behind pilates is only one area of Dr. Dayanim's expertise. She also happens to be the Director of the USC General Practice Residency Program and the Co-Chair of the Department of Dentistry at the LAC+USC Medical Center. A graduate of the University of California, Los Angeles School of Dentistry, Dr. Dayanim went on to complete a postgraduate General Practice Residency (GPR) at Veterans Affairs, West Los Angeles Veterans Administration Hospital. Much like her weekly pilates sessions, Dr. Dayanim has no regrets about completing a GPR program. "Regardless of what kind of program you do, the sheer number of cases you see and the variety and the complexity is very different to what you will see in private practice, in the sense that the cases you will ultimately see in private practice maybe over your 20 years of working, but in one year, you see cases that people working for 10, 20 years have just seen a couple times."

According to the American Dental Association, a GPR program should provide advanced clinical and didactic training in general dentistry with intensive hospital experience at the postdoctoral level. These programs can be one or two years in length and provide instruction and experience in the delivery of care to a wide range of ambulatory and hospitalized

patients. Most GPR programs are sponsored by either a hospital or a hospital-affiliated institution such as a dental school. GPR residents rotate through a variety of services including general medicine, general surgery, and anesthesiology. Each program also includes advanced training and clinical experience in preventive dentistry, periodontics, restorative dentistry, endodontics, and oral surgery. The demand for GPRs has increased over the years. This can be attributed to an aging population, the frequency with which patients take multiple medications, and the endless list of comorbidities that patients exhibit. Post-doctoral training not only gives dental practitioners more experience in a wide range of patients and cases, it also gives them the skills and confidence to deal with more medically complex patients.

USC's GPR program is unique in that its residents see a higher volume and variety of patients than other programs. Residents spend 12 months rotating through LAC + USC Hospital, Veterans Administration, and Ranchos Los Amigos Hospital. These facilities provide more than 5,000 dental patient visits per year. "Some other clinics [are] predominantly healthy, mid 40s-mid 50s patients if you go into a very standard AEGD [Advanced Education in General Dentistry]type program. Here, because we do trauma cases, we see a lot of teenagers who've had trauma from bicycle accidents. Anterior esthetics, which is unique in the dental world, happens so often in private practice, so we get those cases," says Dayanim. She believes the GPR program's unique patient base, resident's autonomy, and unwavering support is what makes it one of the best programs in the country.

As the Program Director and Co-chair of the Department of Dentistry, Dr. Dayanim's role incorporates hospital, programmatic, and educational elements. She is pulled in a multitude of directions, from implementing infection control protocols in the dental clinic to be compliant with Cal/OSHA (Division of Occupational Safety and Health) and Federal standards, to maintaining accreditation for the GPR program. "You always want to be better than what the accreditation standards are because if you are just meeting the standards, it means you are an average program," says Dayanim. "What are the things I can do that perhaps others aren't doing yet that are more innovative? That will push ahead? That will make my program special? That will make people want to ask 'Oh, how did you come up with that?' or 'That sounds really interesting, your residents are so lucky'." The residents certainly are lucky. The program accepts only four students per year from approximately 70-80 applicants, and despite

Dayanim's multitude of responsibilities as Program Director and Clinic Chair, her number one priority is the residents. "My primary goal each day is to ensure the residents feel supported and reach their full potential. I am always striving to ensure that they have the best experience possible and leave each day fulfilled and excited to come back again the next day. At the end of the day - it's all about the residents!"

While the residents are granted a significant amount of autonomy, they are also given support and guidance as needed. Dr. Dayanim does not shy away from serving as a mentor. This mindset is what led to Dayanim's personal success. "My parents were strict on me in terms of doing well in school--it was always about doing the best you could always do. Never being ok with being average, because you can always do better than your own version of average," says Dayanim. She was raised to believe she could do and be whatever she wanted. At the same time, she never took anything for granted. It was not just about pushing herself harder but also about showing appreciation. She always had support but had a little push to keep her moving forward and this is something that has resonated with her, now in her program and her dental career.

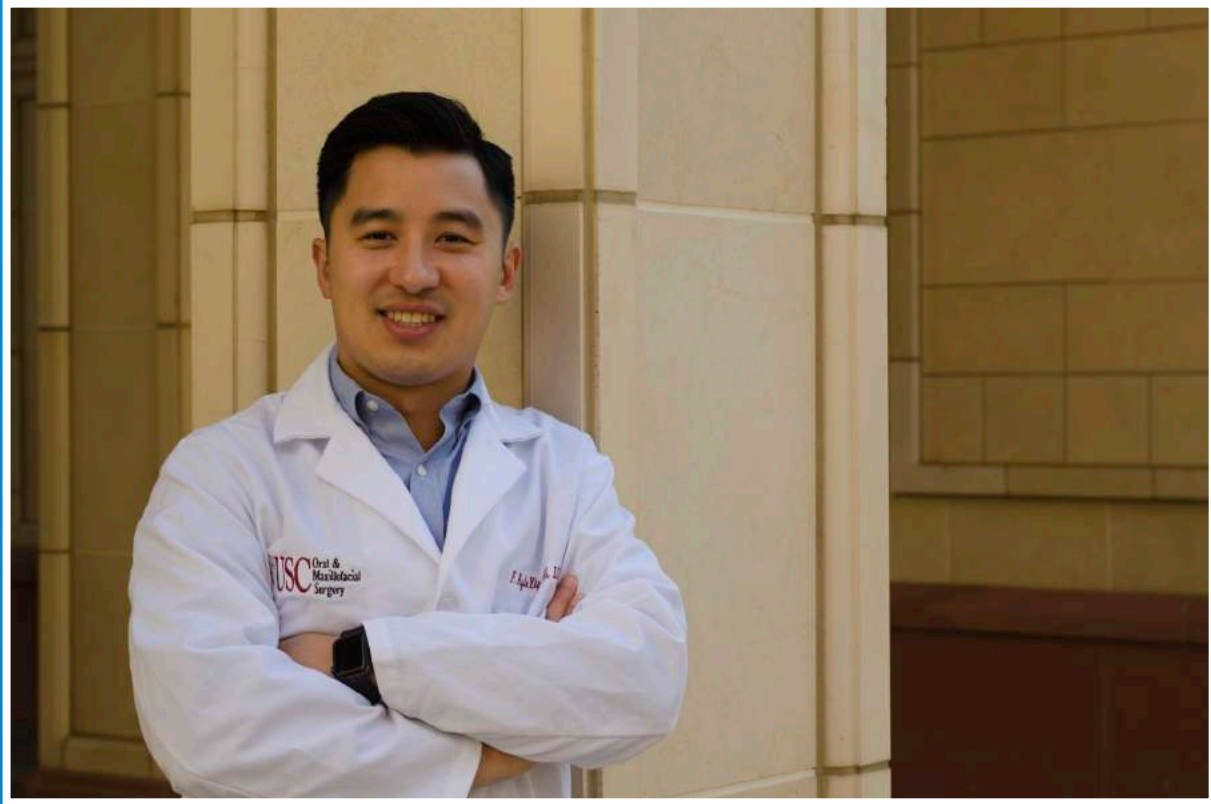
Apart from her role as GPR Program Director and Co-Chair of the Department of Dentistry, Dr. Dayanim also finds time to give back as a leader within the Jewish Federation Community of Professional Women and through Alpha Omega Fraternity (AO). Her involvement with AO started in dental school. After graduation, she became a member of the alumni board and eventually served as the Los Angeles Alumni President from 2015-2016. As the Co-Chair of the Jewish Federation Community of Professional Women, Dayanim recruits women who have started their own companies or women in leadership roles to speak at community events. Their motto for the year is "empowered women empower women" with an ultimate goal of creating a supportive and inspiring network of professionals -- judging by her day job, something Dayanim is becoming quite an expert at.

So, does Dr. Dayanim plan to incorporate pilates into her GPR program curriculum? Not anytime soon, although it's not a bad idea. "It should be mandatory!" says Dayanim, only half joking. For now she will focus on her ADEA presentation, but anything is possible with Dayanim taking the lead.

TECHNOLOGY-DRIVEN CHANGES

in Oral Surgery Education

Scott Barlow and Jiawei Li



Dr. Felix Kyle Yip, MS, DDS, MD is an Assistant Professor of Clinical Dentistry in the Oral and Maxillofacial Surgery department at the Herman Ostrow School of Dentistry of USC. Dr. Yip grew up in the San Gabriel Valley, and always admired his own dentist's ability to improve a patient's health and well-being in just one appointment. He attended UCLA for his Bachelor's, Master's in Oral Biology, and Doctor of Dental Surgery degrees. Directly following his graduation from dental school, he completed a residency in Oral Surgery at USC. Dr. Yip went on to become a Diplomate of the American Board of Oral Maxillofacial Surgery, and continued his involvement in academia by joining USC as a faculty member. While teaching at the Herman Ostrow School of Dentistry, Dr. Yip also sees patients at the LAC + USC Medical Center and in private practice in Arcadia.

Dr. Yip pursued involvement in research early in his career. While completing his undergraduate and graduate studies, he focused on oral biology and published a number of journal articles examining the biological

mechanisms of oral cancer. His publications identified specific proteins involved in human oral carcinogenesis and elucidated the mechanism by which a human papillomavirus-associated oncoprotein disrupts cellular DNA repair mechanisms, leading to genetic instability and oncogenesis. Dr. Yip also demonstrated that once normal human oral keratinocytes have reached their replicative limits, a phenomenon known as replicative senescence, they adopt abnormal repair mechanisms that contribute to genetic instability and cellular aging in the oral cavity.

During his 6-year Oral and Maxillofacial Surgery residency at USC, Dr. Yip merged his passions for scientific research and dental surgery by conducting a retrospective clinical study on the use of a single, non-compression superior-lateral border plate in the treatment of mandibular angle fractures. Angle fractures occur in the posterior mandible, near the wisdom teeth, and are traditionally corrected by the Champy technique: a small plate is strategically placed on the top of the upper border of the mandible to ensure biomechanical retention and proper fracture healing.

While the Champy technique effectively fixes fractures, Dr. Yip demonstrated that alterations in the size of the plate and area of placement can improve treatment outcomes. At USC, a modification to the Champy technique is used, in which a bigger plate is placed on the side of the fracture instead of on top. This lateral placement confers mechanical advantages by better stabilizing fractures and decreasing the incidence of post-surgical complications such as irritation, abnormal healing, and extrusion of the plate.

Dr. Yip believes that the ability to collect, interpret, and critically analyze new information is a fundamental skill for every healthcare professional. To this end, he has incorporated research projects as part of the oral surgery residency curriculum at USC. Dr. Yip encourages his residents to conduct research in disciplines including implant surgery, facial trauma, and orthognathic surgery, with the goal that each resident presents an abstract before graduating. He believes that having residents present their research abstracts at the American Association of Oral and Maxillofacial Surgeons annual national conference ensures that they take an active role in advancing the field of oral surgery and the dental profession as a whole. As a result of these efforts, many residents continue on to publish their findings in respected scientific journals.

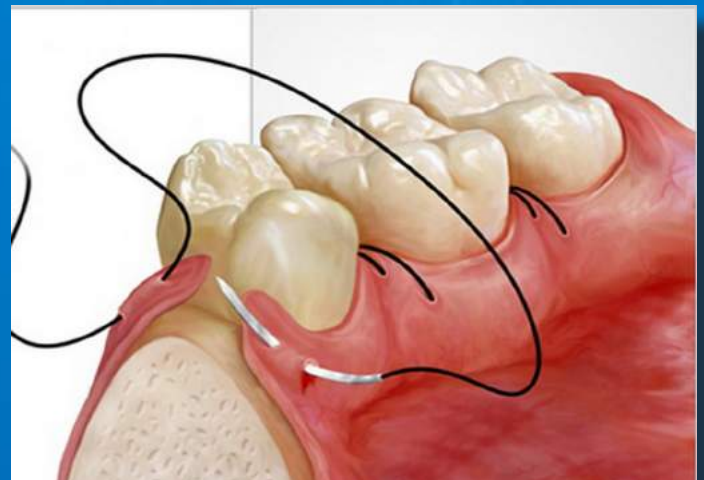
One of Dr. Yip's favorite aspects of the field of oral and maxillofacial surgery is its continuous and rapid evolution. As surgical planning and execution shifts from the use of stone models and 2-dimensional design to virtual and 3-dimensional computer modeling, researchers and clinicians must be willing to question their fundamental knowledge and approach their surgeries with a new perspective. Dr. Yip believes that as technology advances, oral surgeries are simultaneously becoming less invasive in approach and increasingly capable of treating complex cases. New technologies, instrumentation, and techniques have allowed existing procedures to become less surgically invasive via smaller wound margins and minimal iatrogenic damage to surrounding structures, thereby decreasing postoperative pain, promoting faster healing, and providing more reliable outcomes. In addition, technological advancements allow complicated surgeries that were previously difficult to perform, like maxillary reconstruction using vascularized bone, to be executed with fewer complications.

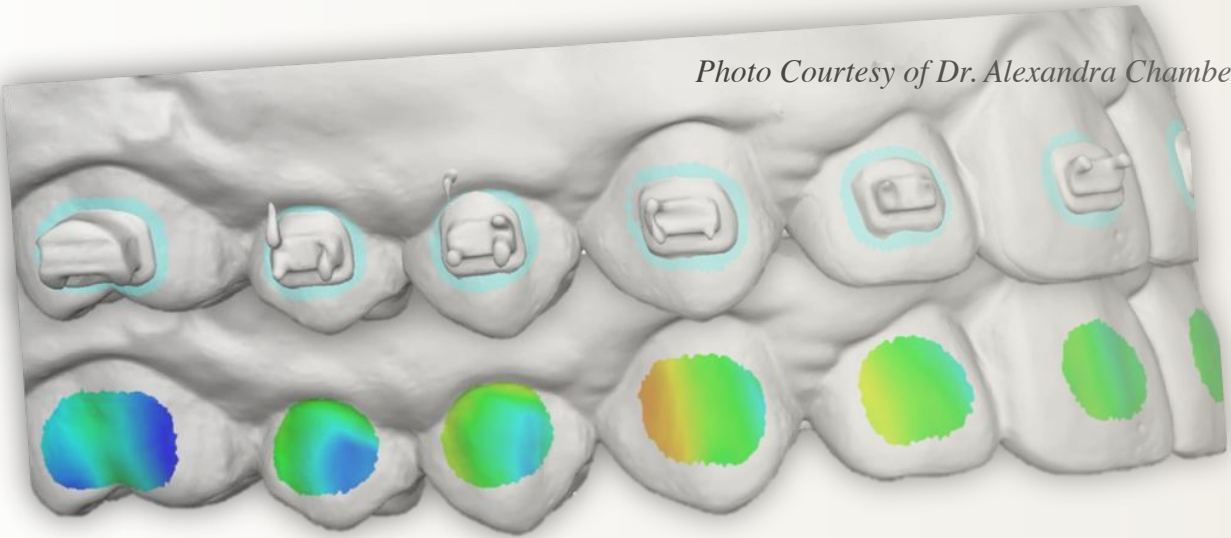
Dr. Yip takes it upon himself to encourage his colleagues and residents to learn about, utilize, and improve upon emerging technologies. He views a lifelong passion for learning as the key to a successful career in oral surgery. In future research projects, Dr.

Yip hopes to explore virtual orthognathic surgical techniques. While 3D scanning techniques allow surgeons to accurately determine where bone will move following placement, predictions of soft tissue movement are less reliable and must be researched further. He also hopes to continue to increase the use of patient-specific materials, such as customized milled or printed titanium plates, in his surgeries.

Dr. Yip is a strong believer in a multidisciplinary approach to patient care. He has provided lectures to dental students concerning odontogenic infections, and plans to create informative continuing education courses available to all students, staff, and faculty. Both by mentoring individual students and serving the Ostrow community, Dr. Yip is committed to making sure that USC-educated dentists and surgeons are not only highly skilled, but also possess the didactic foundation to ask the right questions when determining the techniques and technologies that will best serve each individual patient.

When asked about managing his time, Dr. Yip remarked that "it is easy to find balance in life when you enjoy each aspect." The close relationships he forges with his residents allow him to trust them to be great clinicians, and them to trust him to provide sound guidance and supervision. Outside of teaching and practicing medicine and dentistry, Dr. Yip is a proud father of a newborn daughter, and enjoys golf, basketball, baseball, and travel.





Redefining Patient Care by Digitizing Orthodontics

Meera Sravan Kumar & Neha Agarwal

In all of our lives, we come across different people who change and shape our future. Something similar happened to our very own Dr. Glenn Sameshima. Born in a small town north of San Francisco, California, he graduated with honors in mathematics from UCLA. Although he majored in math, deep down he had a special interest in science. However, he wasn't sure what he wanted to do in science until his family dentist gave his interest a new direction. It was then that he realized his interest in biology, combined with good hand skills, was a combination that would perfectly suit him as a dentist. Coming from a US Air Force Academy, he received a full US Air Force scholarship which helped him attend UCSF Dental School and thus realize his dream of becoming a dentist.

After graduating, he worked as a dentist in the US Air Force for about 7 years, during which time he gained valuable experience in various aspects of dentistry. While doing all those rotations, he realized that he had a special interest in orthodontics. He then decided to pursue residency in Orthodontics and joined the USC Herman Ostrow School of Dentistry.

While doing his MS in Orthodontics, Dr. Sameshima met Professor Michael Melnick, a mathematical geneticist, who saw the hidden talent in this young man. Dr. Melnick was working on a project that involved computers and soon he realized that Dr. Sameshima would be a perfect match for this. Utilizing his background in mathematics and computer programming, Dr. Sameshima jumped into this work of cephalometric analysis and started writing his own statistical programs. He soon switched gears and embarked on a PhD in Craniofacial biology. His skills in this field led him to do his dissertation on 'Finite element analysis of orthodontic

treatment.' As interesting as it sounds, finite element analysis is explained by Dr. Sameshima as "an engineering technique where we look at different landmarks or shapes and compare how they change over time". He collected cephalometric data from various malocclusion cases of patients belonging to different ethnic groups and studied the changes to their faces and dentition over time. Different parameters could also be applied to stress in order to relate the growth changes to the stress.

In 1993, Peter Sinclair became the Chair of Orthodontics and asked Sameshima to join as a full-time faculty member in



1994. He was immediately put in charge of research and technology in the department. He computerized the department and updated courses and seminars. In 2001, he was appointed as Clinic Director. He increased the number of patients seen and brought in more faculty. Sameshima was promoted to the rank of Associate Professor with tenure in 2002 and he became the Chair and Program Director in 2006. He has mentored over 50 MS theses and PhDs and innumerable collaborations with visiting scholars and other institutions. In the 1990s, he and his team published a series of articles examining the accuracy of computer forecasting of growth and surgical outcomes in orthodontic and craniofacial patients. He has presented papers at several major scientific meetings related to dentistry, such as the American Association for Dental Research and International Association for Dental Research. His work with residents has helped several of them win the top prizes in orthodontic research field.

Dr. Sameshima has now been an integral part of the Herman Ostrow School of Dentistry of USC for 30 years. When he joined the Orthodontics program, there were no computers in the department. He greatly expanded the use of technology in the department. His focus has always been towards digitizing orthodontics. Through his continuous efforts, he and his team became one of the first to get state-of-art equipment like cone beam computed tomography scanners, model scanners, and 3D printers. He aspires to do away with traditional impression materials and use intra-oral scanners for all the patients.

His current domain of research interest revolves around root resorption. He says, "for an orthodontist it is critical to have a good understanding about the effects of orthodontic forces on root resorption and study

the factors associated with the same." Whenever orthodontic forces are placed on a tooth, bone is resorbed on the pressure side of the root and deposited on the tension side. The root usually sustains 'collateral damage' but is repaired completely after the forces abate. The problem occurs when irreversible resorption occurs at the root apex, which is not usually able to repair itself. Beginning with two-dimensional periapical radiographs, he transitioned into the advanced technology of three-dimensional model analysis to visualize how teeth move in 3D space. Mastering 3D technology is more difficult but can achieve superior results. As a pioneer in the field, Dr. Sameshima has published twenty papers on this topic and has contributed chapters to the textbooks by Graber and Moyers. He is currently authoring a book on the same topic.

His other areas of interest include scrutinizing the claims about different products put forward by various companies. Since the companies advertise directly to the public, it is important to evaluate their claims carefully. One of the studies done by Sameshima's team showed that a certain type of orthodontic bracket did not reduce treatment time, as claimed by the manufacturer. Currently, he and his team are working on inspecting the accuracy of different 3D printing machines.

Dr. Sameshima believes that dentistry cannot be learned by confining oneself to the four walls of the building. He encourages his residents to participate in international meetings and focuses on keeping the curriculum up to date. He is a strong believer of 'quality over quantity.' In orthodontics, one measure of quality is evaluated by the American Board of Orthodontics: less than half the orthodontists in the US are board certified. With great pride, Dr. Sameshima boasts of his team, all of whom are board-certified members--the

USC Department of Orthodontics the only program in the country with such a stellar faculty. Moreover, eight percent of the local chapter of the Edward H. Angle Society of Orthodontists is comprised of USC faculty, thus making Ostrow's one the most renowned programs in the US. Dr. Sameshima trusts in maintaining a blend in teaching material by treasuring very senior and experienced faculty in addition to younger faculty members. Being a member of the Council of Education for American Association of Orthodontists, he works on the standards of education and the curriculum for the residents and predoctoral programs. Dr. Sameshima is a highly sought-after speaker at international meetings and is considered one of the leading experts on orthodontic root resorption. He is also involved in professional organizations in orthodontics at many levels, including service on the Board of Directors of the Pacific Coast Society of Orthodontists, as a consultant for the ADA Council on Dental Accreditation, and AAO Political Advocacy.

Talking about the change he would like to bring about in the community, Sameshima says "we have a lot of talented students who work hard to get their degrees and want to pursue a research career. But there are very few opportunities and funding." However, he feels that the School's Research Day is a great opportunity for students and young researchers to showcase their work and be recognized for it. Additionally, he would like to extend the scope of community dentistry and the relationship with craniofacial biology, thus being able to interact more with different specialties and making education and research more interdisciplinary. Dr. Sameshima is a visionary who has brought about ingenious innovations. He motivates student researchers and is a continuous source of inspiration for the future of orthodontics and dentistry.

Schedule of Events

April 10th, 2019

08:00 am – 9:00am

Registration (Presenters and Judges)

09:00 am – 12:00 pm

Poster Presentations Judging

11:30 am – 12:00 pm

General Registration

11:30 am – 12:30 pm

Lunch

12:30 pm – 12:45 pm

Opening Remarks

Randolph Hall

Vice President of Research

Avishai Sadan

Dean

Yang Chai

Associate Dean of Research

12:45 pm – 01:15 pm Keynote Speaker: Carl Kesselman

Dean's Professor of Industrial and Systems Engineering and Fellow in the Information Sciences Institute in the Viterbi School of Engineering

Professor of Preventive Medicine at the USC Keck School of Medicine

Director of the Informatics Systems Division at ISI

01:20 pm – 01:40 pm Keynote Speaker: Neema Bakhshalian

Assistant Professor of Clinical Dentistry

Division of Periodontology, Diagnostic Sciences & Dental Hygiene

Herman Ostrow School of Dentistry of USC

01:45 pm – 02:05 pm Keynote Speaker: Pinghui Feng

Professor of Dentistry, Section Chair, Infection and Immunity

Division of Periodontology, Diagnostic Sciences & Dental Hygiene

Herman Ostrow School of Dentistry of USC

02:10 pm – 02:40 pm Keynote Speaker: Lisa Aziz-Zadeh

Associate Professor of Occupational Therapy

Chan Division of Occupational Science and Occupational Therapy

University of Southern California

02:45 pm – 04:30 pm Poster Viewing

04:30 pm – 05:00 pm Award Presentations

05:00 pm – 06:00 pm Reception

03:30 pm – 05:30 pm Career Fair (Hall of Fame, South)

Keynote Speakers

Carl Kesselman

Dr. Carl Kesselman is a Dean's Professor of Industrial and Systems Engineering and a Fellow in the Information Sciences Institute (ISI) in the Viterbi School of Engineering and a Professor of Preventive Medicine in the Keck School of Medicine at the University of Southern California. He is also the Director of the Informatics Systems Division at ISI and leads the Center of Excellence for Discovery Informatics in the Michelson Center for Convergent Biosciences. He received a Ph.D. in Computer Science from the University of California, Los Angeles, a Master of Science degree in Electrical Engineering from the University of Southern California, and Bachelor's degrees in Electrical Engineering and Computer Science from the University at Buffalo. He is a fellow of the Association for Computing Machinery and the British Computing Society. His work in large-scale information systems has received numerous honors including the Ada Lovelace Medal from the British Computing Society. He is also a recipient of an honorary Doctorate degree from the University of Amsterdam.

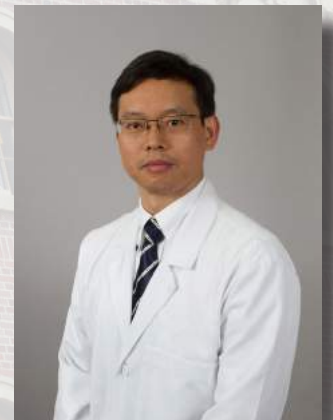


Neema Bakhshalian

Dr. Neema Bakhshalian is an Assistant Professor of Clinical Dentistry in the Division of Periodontology, Diagnostic Sciences and Dental Hygiene at the Herman Ostrow School of Dentistry of USC. He specializes in Periodontology and implant Dentistry. In addition to completing his DDS degree, he was awarded his PhD from the Florida State University where his work focused on Bone Biology. He subsequently completed his residency and subspecialty training in Periodontology and Implant Dentistry at the University of Southern California. In 2015 he became a diplomate of the American Board of Periodontology. Dr. Bakhshalian has published extensively in the area of bone regeneration and tissue engineering. He is a member of several professional organizations such as the American Dental Association, American Academy of Periodontology, and the Academy of Osseointegration.

Pinghui Feng

Dr. Pinghui Feng is a Professor of Dentistry. He serves as the Section Chair of Infection and Immunity in the Division of Periodontology, Diagnostic Sciences and Dental Hygiene at the Herman Ostrow School of Dentistry of USC. Dr. Feng obtained his PhD in Cell Biology and Biophysics at the University of Missouri and completed a postdoctoral research training Science at Harvard Medical School and an Assistant Professor at the University of Texas Southwestern Medical Center before joining the Keck School of Medicine. Dr. Feng's research focuses on interaction between herpes viruses and host innate immune system during infection and pathogenesis and touches a wide range of topics that include cancer, infectious diseases, drug development and immunotherapy.



Lisa Aziz-Zadeh

Associate Professor Dr. Lisa Aziz-Zadeh trained at the University of California, Los Angeles, receiving her BA degree in psychology with a minor in neuroscience, and her PhD degree in Psychology with an emphasis in Cognitive Neuroscience. She completed postdoctoral work with Dr. Giacomo Rizzolatti's laboratory at the University of Parma (Italy), Dr. Richard Ivry's laboratory at the University of California, Berkeley, and was a fellow at the UCLA Tennebaum Family Creativity Initiative. She has published numerous papers and book chapters on the mirror neuron system, embodied cognition and language. Her current work focuses on applying the neuroscience of embodied cognition to understanding disorders such as autism, dyspraxia, and motor impairment after stroke.

Advanced Dentistry Specialty Program Residents

CBY/PIBBS Graduate Students

Post-Doctoral Fellows

Undergraduate and DDS Students - Basic Sciences

Undergraduate and DDS Students - Clinical Sciences

Biokinesiology and Physical Therapy PhD Candidates

Biokinesiology and Physical Therapy PhD Students

Occupational Science & Occupational Therapy Doctoral
Students

Dean's Research Award

POSTER

CATEGORY

AWARDS

USC STEVENS CENTER FOR INNOVATION AWARDS

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

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

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

SOUTHERN CALIFORNIA SECTION OF THE AADR DENTAL STUDENT RESEARCH AWARD

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

DR. ANSEL WATROUS FACULTY RESEARCH AWARD

Photo Courtesy of Mehrdad Razaghy

PHOTO CREDITS

Front & Back Cover Photo Courtesy of Dr. Eva Janečková. Visualization of *Osr2-Cre;tdTomato* reporter mice at E16.5 in the soft palate region. Frontal section of the mouse head, specifically in the region of the tensor veli palatini muscle, which is wrapping around the pterygoid plate. Double staining of RFP (red, tdTomato signal) and MHC immunohistochemistry (green).

Photo Courtesy of **Dr. Eva Janečková**. Pages 1, 62, 75, 78

Photo Courtesy of **Mehrdad Razaghy** '19. Pages 2, 13, 36, 38, 42, 47, 55, 57

Photo Courtesy of **Dr. Amy Merrill**. Page 15

Photo Courtesy of **Dr. Alexandra Chamberlain**. Page 32

Photo Courtesy of **Dr. Jian Wu**. Page 37

Photo Courtesy of **John Skalicky**. Page 21



RESEARCH DAY

POSTER ABSTRACTS

DENTISTRY DIVISION FACULTY

Poster #1

Title: Learner-centered dental admissions: 1. Implementation of the multiple mini-Interview

Authors: Anita Tourah, Mahvash Navazesh, & Robin Fox

Background: Evaluation of cognitive skills and academic abilities is a significant component of higher education admissions. Non-cognitive attributes such as empathy, integrity, ethical decision-making, effective communication, and leadership skills are also desirable and important for health-care providers, enabling them to adapt to their profession. The Problem-based Learning (PBL) interview has been used by the DDS program of the Herman Ostrow School of Dentistry for 20 years, evaluating candidates' communication, teamwork, and leadership skills. **Purpose:** We added the Multiple Mini-interview (MMI) in September 2018 to evaluate applicants' empathy, integrity and ethical decision-making. We describe implementation of the MMI as an admission tool for the School. **Methods:** MMI interviewers were calibrated and MMI scenarios were identified. Scenarios were selected from the ProFitHR Candidate Assessment System developed by McMaster University (Canada). **Results:** 46 faculty (5 Div. I; 11 Div. II; 6 Div. III; 15 Div. IV; 7 Div. V; 2 Div. VI) and 6 staff were calibrated as MMI interviewers. Each applicant was evaluated on 4 case scenarios. Two interviewers independently rated each applicant using a 1-5 scale. Generally, the same interviewers

were paired; the pairs consistently evaluated applicants on the same scenario. Through mid-January 2019, 332 applicants were interviewed. **Conclusion:** The MMI process was well-received by faculty/staff interviewers and was incorporated into the existing interview process without difficulty. Potential outcomes of this addition will be assessed over time.

Poster #2

Title: Flat plane appliances for muscle-related TMD

Authors: Jon Delsnyder, Thomas Colina, Nagy Elsemary, Reyes Enciso, & Mariela Padilla Guevara

Purpose: The objective of this study was to determine if the use of flat stabilization appliances would benefit patients with myogenous temporomandibular disorders. **Methods:** The studies chosen were randomized controlled trials which evaluated flat plane stabilization splints (SS) versus non-occluding palatal splints (NOS) for the treatment of myogenous temporomandibular disorders. The Cochrane Library, Medline through PubMed and Web of Science were searched for studies which met the criteria mentioned above. **Results:** Review authors assessed 544 unduplicated references which were reduced to eight randomized controlled clinical trials. Four were assessed at unclear risk of bias and four were at high risk. Patients wearing a flat plane stabilization splint only at night had a significantly better reduction in pain intensity ($p=.015$), and the subjects had a greater chance to have a 50% or more of reduction of pain intensity ($p=.037$) than

patients wearing a non-occluding splint. However, there were no statistically significant differences between SS worn 24 hours a day and a non-occluding splint in reduction of pain intensity ($p=.646$) or number of responders to treatment ($p=.323$). There were no significant differences detected between SS (worn at night or 24 hours a day) and NOS in any of the other outcomes measured (tenderness of muscles of mastication at palpation, interincisal opening or clicking). **Conclusion:** There is low quality of evidence to support the use of flat stabilization splints worn only at night or 24 hours to provide a reduction of pain intensity in the treatment for myogenous temporomandibular disorders. Large RCTs with lower risk of bias and standardized methodology comparing stabilization splints to non-occluding splints are needed to confirm these results.

Poster #3

Title: CAD inhibits NF-kappaB activation while promoting aerobic glycolysis via deamidating RelA

Authors: Jun Zhao, Mao Tian, Alireza Delfarah, Brian Gao, Larissa Bubb, Nicholas A. Graham, & Pinghui Feng

Aerobic glycolysis, better known as "Warburg effect", is the preferential conversion of glucose into lactate even with sufficient oxygen supply, and a hallmark of cancer cells and normal proliferating cells. The mechanisms of metabolic reprogramming during proliferation are not well understood. Protein deamidation is emerging as a post-translational modification that regulates protein

function. Our recent studies of herpesvirus immune evasion implicate cellular glutamine amidotransferases (GATs) in deamidating key signaling molecule. Here, we report that the rate-limiting enzyme of pyrimidine synthesis, a trifunctional GAT containing activity of carbamoyl phosphate synthetase, aspartyl transcarbamoylase and dihydroorotase (CAD), deamidates the RelA subunit to inactivate NF-kappaB and promote aerobic glycolysis. Functional screen and biochemical analysis demonstrated that CAD deamidated RelA to negate NF-kappaB activation. In proliferating cells, CAD is activated and catalyzes de novo pyrimidine synthesis to meet the metabolic need during S phase. CAD-mediated RelA deamidation and NF-kappaB inactivation paralleled in a cell cycle-dependent manner. In addition, CAD promoted glycolysis via deamidated RelA that up-regulated the expression of key glycolytic enzymes. Stratification of cancer cell lines by CAD-mediated RelA deamidation predicted their sensitivity to inhibitors of glycolytic enzymes, while a subset of cancer-predisposed mutations of RelA promoted RelA deamidation and glycolytic metabolism. This work describes a metabolic reprogramming enabled by CAD-mediated RelA deamidation that underpins cell proliferation and cancer development.

Poster #4

Title: Repeatedly applied peptide film kills bacteria on dental implant

Authors: Cate Wisdom, Casey Chen, Esra Yuca, Yan Zhou, Candan Tamerler, & Malcolm L. Snead

Background: The rising use of titanium dental implants

has increased the prevalence of peri-implant disease that shortens their useful life. A growing view of peri-implant disease suggests that plaque accumulation and microbiome dysbiogenesis triggers a host immune inflammatory response destroying soft and hard tissues supporting the implant. **Purpose:** We report a water-based, non-surgical approach to address peri-implant disease using a bifunctional peptide film, which can be applied during the initial implant placement and later, can be re-applied to existing implants to reduce bacterial growth. **Methods:** Bifunctional peptides are based upon a titanium binding peptide (TiBP) optimally linked by a spacer peptide to an antimicrobial peptide (AMP). Dental implant surfaces covered with a bifunctional peptide film kills bacteria. Further, using a simple protocol for cleaning implant surfaces fouled by bacteria, the surface can be effectively re-coated with TiBP-AMP to regain an antimicrobial state. **Results:** Fouling, cleansing, re-binding was confirmed for up to four cycles with a minimal loss of binding efficacy. **Conclusion:** A water-based, non-surgical approach to address peri-implant disease using a bifunctional peptide film applied during the initial implant placement or at retreatment for existing implants was demonstrated. This technology represents a paradigm shift in the prevention of dental implant failure while adding to the range of bioactive molecules that can be anchored to implant surfaces to improve their function, such as osteointegration. Rebinding after fouling of a water-based film extends control over the oral microbiome composition providing a novel non-surgical treatment for dental implants.

Poster #5

Title: Efficacy of saliva substitutes/stimulants in the treatment of dry mouth

Authors: Mehdi Mohammadi, Lydia See, Reyes Enciso, Phuu Han, & Roseann Mulligan

Background: Older adults are living longer and experiencing multi-morbidities resulting in polypharmacy. A major adverse effect of this is dry mouth. Due to the cost and associated side effects from existing cholinergic agonists, topical saliva substitutes and stimulants have been utilized as a viable alternative.

Purpose: To evaluate the efficacy of saliva substitutes and stimulants compared to placebo in improving findings of dry mouth not caused by Sjögren's Syndrome. **Methods:** Four databases were searched (PubMed, Web of Science, Cochrane Library and EMBASE) through 3/2018. Only RCTs with dry mouth patients where interventions compared to placebo were included. Outcomes included salivary flow and self-reported patient improvement. The Cochrane Collaboration's tool for assessing risk of bias was used. A meta-analysis with subgroup analyses was performed. **Results:** A total of 348 references were reviewed, resulting in inclusion of seven RCTs with 257 dry mouth patients. Five studies had high risk of bias, one unclear and one low risk. In two studies, 1% malic acid topical spray increased unstimulated (Difference in Means [DM]=0.096, 95% CI=0.092-0.100; $p<0.001$) and stimulated (DM=0.203, 95% CI=0.106-0.300; $p<0.001$) salivary flow compared to placebo groups. In two studies, patients using 1% malic acid topical spray were 5.4 times more likely to report improvement compared to placebo (95% CI=2.634-11.091; $p<0.001$). No significant improvements were found with other products. **Conclusion:** Use of 1% malic acid topical spray seems to improve dry mouth compared to placebo. Quality of the evidence was low due to risk of bias and imprecision; further studies are needed.

Poster #6

Title: Peptide amphiphile nanofibers potentiate canonical Wnt signaling through caveolae

Authors: Yan Zhou, Samuel I. Stupp, & Malcolm L. Snead

Background: Bioactive peptide amphiphile (PA) nanofiber matrices that self-assemble 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. Canonical Wnt signaling 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. LDL receptor protein-related factor 6 (Lrp6) phosphorylation in raft membrane domains and subsequent internalization into signaling-competent vesicles (caveolae) are essential for Wnt pathway activation. **Purpose:** The requirement of caveolae was characterized in PA-mediated potentiation of canonical Wnt signaling. **Methods:** The caveolin-mediated endocytosis was inhibited, thereby blocking the formation of caveolae. **Results:** PA-mediated potentiation of canonical Wnt signaling was abolished. **Conclusion:** Caveolae is required for the potentiation of canonical Wnt signaling by PA nanofibers.

Poster #7

Title: Herpesvirus infection in oral inflammation

Authors: Pinghui Feng

Herpesviruses are ubiquitous in human and their infections cause significant morbidity and mortality in immune-compromised individuals, such as the elderly or AIDS patients. Oral cavity is an important compartment that is conducive for herpesvirus replication and dissemination. Accumulating clinical studies, especially those from Dr. Slots's group, suggest that human herpesviruses exacerbate periodontal inflammatory diseases, such as periodontitis, peri-implantitis and gingivitis. We are interested in the role of herpesvirus infection in the oral inflammatory diseases, with a focus on bacteria-herpesvirus interaction.

One possible mechanism by which herpesvirus promotes bacterial infection is through their notorious strategies to derail host immune responses. My laboratory has recently discovered that herpesvirus hijacks cellular metabolic enzymes to inactivate innate immune signaling pathways. As such, viral replication is significantly increased, which may also fuel bacterial infection. I will discuss some ongoing research in the laboratory.

ADVANCED SPECIALTY PROGRAM RESIDENTS

Poster #8

Title: Dental effects on alveolar bone graft for craniofacial cleft treatment

Authors: Andrew Palermo

Faculty advisor: Stephen Yen

Background: Secondary alveolar bone grafting (SABG) is critical in the treatment of craniofacial clefts with alveolar involvement. With the advent of cone beam computer tomographic images, we can safely and routinely produce 3-D radiographs to evaluate the cleft prior to grafting. **Purpose:** The purpose of this study is to evaluate the cleft-site of patients with craniofacial clefts with alveolar involvement for predisposing factors that may compromise the graft outcome. **Methods:** CBCT's were taken (Carestream CS 9300) on 52 patients (ages 7-12 years old) with cleft lip and palate 6 months following their secondary alveolar bone graft at Children's Hospital, LA. Carestream proprietary software and Osirix MD DICOM viewer were used to render 3-D and 2-D images to evaluate the graft outcome as either type I (full bony graft), type II (coronal/cervical bridging), type III (apical bridging) or type IV (full graft failure). The software was then used to evaluate the cleft-margins for: suc-

cedaneous canine position, existence of impacted teeth and bone loss around the teeth adjacent to the cleft-site. **Results:** The most common graft outcome was type III followed by type IV, type II and type I was the least common. Statistically significant results were found for canine position ($p=0.0404$) and bone loss of adjacent teeth ($p=5.34 \times 10^{-5}$), but not for impacted teeth ($p=0.7730$). **Conclusion:** Significantly worse graft outcomes were associated with tooth-related bone loss around the cleft margins. The results of this study suggest that teeth that compromise the cleft margin should be extracted prior to SABG.

Poster #9

Title: Assessment of 3D surface changes following virtual bracket removal

Authors: Alexandra Chamberlain, Andre Weissheimer, & Kaifeng Yin

Faculty advisor: Andre Weissheimer

Background: Computer-aided design and manufacturing of orthodontic retainers from digitally deboned models can be used to facilitate same-day delivery. **Purpose:** The purpose of this study was to 1) establish reliable virtual bracket removal (VBR) techniques using two 3D modeling software programs and 2) assess their accuracy and reproducibility. **Methods:** The sample consisted of nine 3D-printed maxillary models that were digitized with an intraoral scanner for use as a control group. The control models were bonded with labial brackets and scanned. VBR was performed using Ortho Analyzer™ (3Shape A/S, Copenhagen, Denmark) and Meshmixer™ (Autodesk, San Rafael, CA). The virtually deboned models were superimposed onto the control models, and 3D Euclidean distances between surface points of superimposed models were calculated for comparative analysis of surface changes due to VBR. Surface changes were expressed via color mapping. **Results:** Inter- and in-

tra-operator reliability were determined to be high (> 0.9). The accuracy of VBR did not differ significantly between software programs. However, statistically significant differences ($P < 0.05$) were detected between tooth segments (incisors, canines/premolars, and first molars), with VBR in the posterior segments showing the least accuracy. **Conclusions:** Virtual bracket removal is accurate and reproducible when using the protocols established in this study. Both Ortho Analyzer™ and Meshmixer™ can be used for the computer-aided design and manufacture of retainers.

Poster #10

Title: Facial Trigger Points Locations in Myofascial Pain Patients: Retrospective Study

Authors: Erick Gomez-Marroquin, Tarun Mundluru, Mariela Padilla, & Glenn Clark

Faculty advisor: Mariela Padilla

Background: The term trigger point in myofascial pain syndrome involves muscle stiffness, tenderness, and pain that radiates to other areas of the body, a condition that should be considered when examining a patient with facial pain of non-dental origin. **Purpose:** In this retrospective study, we examined the trigger point location in patients with myofascial pain in the masticatory muscles. We proposed that trigger points are more frequently found in the mandible closing muscles (masseter and temporalis). **Methods:** This study was conducted at the Orofacial Pain and Oral Medicine Center, with data from 47 charts of patients who were diagnosed with Myofascial Pain and received 1-2 trigger point injections from January 2016 to December 2018. The results were analyzed using descriptive statistics with Excel. **Results:** In 76.6% of the cases, Myofascial Pain was included as the first diagnosis, identifying at least one trigger point. The left superficial masseter muscle was the most frequent location of the trigger points (42.6%), followed by the right superficial

masseter (21.3%) and bilateral superficial masseters (12.8%). The temporalis muscle was not a common site for a trigger point, with just one case injected on that site. **Conclusion:** The most frequent location for a facial trigger point was the masseter muscle, which is jaw closer muscle. When dealing with facial pain of non-odontogenic origin, the clinician should examine those muscles to rule out myofascial pain.

Poster #11

Title: Evaluating the efficiency of Carriere Distalizer: comparison of Class-II appliances

Authors: Kaifeng Yin, Eugene Han, Jing Guo, Toshihiko Yasumura, Dan Grauer, & Glenn T. Sameshima

Faculty advisor: Glenn T. Sameshima

Background: Although Carriere distalizer has been growing in popularity among clinical practitioners over the last decade, few studies are available to evaluate the treatment efficiency of Carriere Distalizer for Class II correction. **Purpose:** To evaluate the treatment efficiency of Carriere distalizer in comparison to Class II intermaxillary elastics and Forsus. **Methods:** Three groups of patients treated with Class II intermaxillary elastics ($n=18$), Carriere Distalizer ($n=18$), and Forsus appliance ($n=18$) were collected. The data consisted of cephalometric and study model measurements from pre- and post-treatment records and treatment time. Two-tail student t test was used to analyze the differences in cephalometric and dental changes between Carriere distalizer group and Class II elastics/Forsus group. **Results:** All three groups showed no differences in the age of treatment initiation, pre-treatment cephalometric measurements and Discrepancy Index (DI). The time of Class II correction for Carriere Distalizer was significantly shorter than that for Class II elastics; there was no difference in the length of Class II correction between Carriere

Distalizer and Forsus groups. The amount of Class II correction was significantly lower for Carriere Distalizer when compared with Forsus appliance. Carriere Distalizer, similarly to Class II elastics, did not induce any statistically significant correction in skeletal component (ANB and Wits appraisal). **Conclusion:** There is a lack of skeletal correction induced by Carriere Distalizer in growing patients. Carriere Distalizer can be effectively applied to treatment of mild to moderate Class II dental malocclusion over 6 months on average, although the total treatment time may be prolonged.

Poster #12

Title: Effect of different barriers on output of light curing units

Authors: Fares Albalawi & Jin-Ho Phark

Faculty advisor: Jin-Ho Phark

Background: Sufficient light output is essential for proper polymerization for dental restorations. However, barrier materials for infection control purposes could lead to compromised quality of light output emitted from light curing units. **Purpose:** To assess the effect of different barriers on light output emitted from LED light curing units. **Methods:** Five units (LED, Valo, Ultradent) were tested for light output using a radiometer (Bluephase Meter II). Each unit was measured 10 times under nine different barrier conditions: G1-without any barrier (control group), G2-single layer barrier tape, G3-double layer barrier tape, G4-single layer syringe cover, G5-double layer syringe cover, G6-single layer kitchen wrap, G7-double layer kitchen wrap, G8-single layer Valo sleeve, G9-double layer Valo sleeve. **Results:** The highest light output measurements (1460.8 mW/cm^2) was recorded for the control group (G1). Light output was decreased in groups with one layer of barrier material (G6, G8, G4, G2), ranging from 1387.2 mW/cm^2 to 1367.4 mW/cm^2 . The lowest light output measurements were measured

for groups with double layers of barrier material (G3, G9, G5, G7), ranging from 1315.0 to 1340.8 mW/cm². **Conclusion:** Barrier materials for infection control purposes decrease the light output of light curing units. Light output decreases even more when barriers are placed in double layers. Thus, type and thickness of barrier materials need to be considered for effective polymerization of dental restorations.

Poster #13

Title: Patient reported outcome measures (PROMs) and pain experience of three coronal advancement methods for the treatment of multiple gingival recession defects

Authors: Julio Moreno-Aleman Sánchez

Faculty advisor: Homa H. Zadeh

Purpose: The aim of this RCT was to evaluate the patient reported outcomes (PROMs) of patients undergoing three different interventions for the treatment of multiple gingival recession defects and attempt to compare post-operative pain of 3 modalities for coronal advancement of gingival margins to achieve root coverage: Coronally Advanced Flap (CAF), Vestibular Incision Subperiosteal Tunnel Access (VISTA) and Intrasulcular tunneling (IST). **Background:** Understanding patients' experience is an important determinant in selecting appropriate therapeutic modality. There is inadequate evidence to allow comparison of PROMs as an outcome measure for patients undergoing therapy for gingival recession defects. **Methods:** Participants with Miller class I, II or III recession defects are currently being recruited for this study. Three days after the intervention, a visual analog scale (VAS) was administered to the volunteers to assess PROMs, including pain experience. Analgesic use was determined by counting the number of analgesic tablets used by each patient. **Results:** Initial data revealed high degree of variability in pain experience and in analgesic use. A questionnaire will be completed by the participants at

the end of the 12-month follow up. **Conclusion:** PROMs are a crucial element of recognizing patient experience. Further recruitment is needed to support these findings and evaluate PROMs of different modalities for the treatment of gingival recession.

Poster #14

Title: 3D Printing and Dental Impaction in Orthodontics

Authors: Kaifeng Yin, Toshiko Yasumura, Jing Guo, & Glenn T. Sameshima

Faculty advisor: Glenn T. Sameshima

Purpose: The purpose of the study is to introduce a workflow using 3D-printed premaxilla models to facilitate diagnosis and treatment planning of dental impaction in clinical orthodontics. **Methods:** The pre-operative CBCT files of seven cases with impacted upper canines or central incisors were selected from advanced orthodontic clinic at University of Southern California (2016-2017). 3D reconstruction and manual segmentation were conducted using Mimics 20.0 software package. The exported STL files were further cleaned up with the tools incorporated in Autodesk Mesh-Mixer 3.5. 3D printing was performed using Formlabs 2 SLA 3D printer with grey resin. The resolution was set at 100 micron. To test the acceptance of 3D printed maxillary models among patients/parents, orthodontists, and periodontist/oral surgeons, we conducted a pilot survey involving 5 questions. Only patients' premaxillas with impacted teeth were preserved in 3D-printed models. The buccal/palatal cortical bone covering the crowns of the impacted teeth were removed during segmentation, so that the position of impacted teeth relative to neighboring teeth was better shown from 3D models. **Results:** All three populations-patients/parents, orthodontists, periodontist/oral surgeons-showed high acceptance rate of 3D models in aspects of patient communi-

cation, diagnosis and treatment planning. Compared to the other two groups, a significantly higher proportion of patients/parents believed more information about impacted teeth was obtained from 3D-printed models than from CBCT images/conventional x rays/photos only. **Conclusions:** 3D printer premaxilla with impacted teeth are advantageous to communication with patients/parents and dental specialists. Therefore, 3D printer models should be widely applied to diagnosis and treatment of dental impaction in clinical orthodontics.

Poster #15

Title: An Overview of the Dental and Skeletal Relationships in Individuals of Vietnamese Ancestry

Authors: Tiffany Hudson, Thuan Le, & Glenn T. Sameshima

Faculty advisor: Glenn T. Sameshima

Background: Treatment norms have historically been based off of Caucasian populations. Studies have since been conducted on a variety of racial groups in order to provide ethnic-specific reference norms. **Purpose:** To establish an overview of the dental and skeletal relationships in Vietnamese individuals. **Methods:** Initial patient records (n=124) of immigrant or first generation Vietnamese-Americans were collected from a private practice in Canoga Park, CA, and used (n=119) in this study. Study models were evaluated for Angle classification, overjet, overbite, tooth shoveling, crossbites, and arch form. Lateral cephalograms were digitally traced using Steiner and Wits analyses. Descriptive statistics were completed and compared to corresponding data previously published on other ethnicities. **Results:** Class I, II, and III molar relationships were observed in order of decreasing frequency. The mean overjet and overbite were 3.5 mm and 2.7 mm respectively. Tooth shoveling was exhibited in 39.5% of the sample and crossbites were

present in 47.9% of the patients. Ovoid arch forms were the most common in the maxilla (68.0%) and mandible (60.5%). The mean ANB and SN-GoGn were 3.1° and 37.3° respectively. Males and females showed a mean Wits value of -0.67 mm and -0.92 mm respectively. **Conclusion:** Vietnamese individuals displayed the following dental features: primarily Class I dental, elevated overjet and overbite values compared to ideal, reduced tooth shoveling compared to previous reports, increased crossbite distribution, and primarily ovoid arch forms. They also demonstrated elevated ANB and steep mandibular plane angles.

Poster #16

Title: Radiographic analysis of guided bone regeneration with tenting screws

Authors: Navid Nobaharestan, Christopher Pham, Shahriar Agahi, & Sanchita Mehra

Faculty advisor: Homa H. Zadeh

Background: Horizontal and vertical resorption of the alveolar crest following tooth loss compromises esthetic and functional outcomes of endosseous implant placement. Various surgical techniques have been proposed to augment the edentulous ridge, such as guided bone regeneration (GBR) with tenting screws. However, the efficacy of these techniques have not been thoroughly evaluated. **Purpose:** The primary aim of this retrospective study is to radiographically assess the horizontal and vertical dimensional changes in the alveolar bone following treatment with GBR and tenting screws. The secondary aim is to examine the effects of the tenting screws by analyzing the post-therapy dimensional changes of the alveolar bone at various distances relative to the tenting screws. The tertiary aim is to evaluate the effect of initial recipient site bone morphology on post-therapy dimensional changes. **Methods:** The study population includes those patients who had been treated

with GBR and tenting screws at USC Herman Ostrow School of Dentistry Department of Periodontology. Inclusion criteria consisted of: 1) the availability of pre- and post-therapy diagnostic quality CBCTs, 2) treatment performed between January 2008 to present time, 3) the alveolar ridge augmentation technique utilized particulate bone with resorbable barrier membrane and tenting screws. Exclusion criteria consisted of: 1) alveolar bone augmentation techniques not utilizing the combination of particulate bone with resorbable barrier membrane and tenting screws, 2) non-diagnostic CBCTs. The CBCTs taken at pre- and post-therapy will be superimposed in an imaging software (Amira) to quantify linear and 3-dimensional changes of the alveolar bone.

Poster #17

Title: Familiarity of California pediatric dentists in treating children with ADD/ADHD

Authors: Tiffany Barrett & Thomas Tanbonliong

Faculty advisor: Thomas Tanbonliong

Purpose: The purpose is to assess the familiarity of California pediatric dentists with the American Academy of Pediatrics and American Academy of Child and Adolescent Psychiatry guidelines in treating medically diagnosed ADD/ADHD pediatric patients and determine relative success rates of treating them in pediatric dental practices within office sedation procedures. **Methods:** An electronic questionnaire was sent to 732 California pediatric dentists. The questionnaire consisted of 21 questions regarding knowledge with treating ADD/ADHD pediatric patients in the dental office setting. **Results:** TBD **Conclusion:** TBD



Poster #18

Title: Efficacy of trigger points to reduce VAS in myofascial pain patients: retrospective study

Authors: Tarun Mundluru, Erick Gomez-Marroquin, Mariela Padilla, & Glenn Clark

Faculty advisor: Glenn Clark

Background: A trigger point is hyper irritated area located in the taut band of a muscle that on palpation radiates pain. Presence of trigger point in the muscle and radiating pain is characteristic of myofascial pain syndrome. There are several treatment strategies to treat myofascial pain. Injection the local anesthesia into the trigger point region is one among them. **Purpose:** To examine the effectiveness of the trigger point injections in pain reduction perceived by the masticatory myofascial pain patients. **Methods:** This is a retrospective study conducted at the Orofacial Pain and Oral Medicine Center based on the clinical data collected from January 2016 to December 2018. 26 patients who received 1-2 trigger point injections were involved in the study. Pain levels were recorded using the VAS analogue scale before and after the trigger point injection. The VAS scores were compared and statistical analysis was conducted using the normality test (Shapiro-Wilk), and a paired t-test. **Results:** Pre- and post-treatment VAS pain was measured in 26 patients. Both variables passed the normality test ($p > 0.05$). The average reduction in pain on VAS scale was 1.27 units on a scale 0-10 with a standard deviation of 2.27 and this change was statistically significant ($p = 0.009$). **Conclusions:** The use of a trigger point injection is a successful strategy for the treatment of Myofascial Pain in the Orofacial region, with a reduction on the patient's perception of pain measured by the visual analogue scale.

Poster #19

Title: A case report of outpatient dental treatment for patient with CRPS utilizing deep sedation/general anesthesia with an infusion of ketamine

Authors: Tarun Mundluru, Mana Saraghi, & James W. Tom

Faculty advisor: James W. Tom

Background: Complex regional pain syndrome (CRPS) is a potentially debilitating form of neuropathic pain that often manifests following a traumatic injury or surgery. CRPS is also known as algodystrophy, causalgia, or reflex sympathetic dystrophy (RSD.) Patients describe unbearable burning pain from non-nociceptive stimuli, such as when taking a shower or brushing against another object. The regular tactile stimuli encountered during routine restorative dental procedures may not be well tolerated by a patient with CRPS. Ketamine infusions have been reported to help alleviate the acute flares of CRPS symptoms. **Results:** We are presenting a case report of successful outpatient dental treatment utilizing deep sedation/ general anesthesia with an infusion of ketamine in a 35 year-old female patient diagnosed with CRPS who had poor intravenous access.

Poster #20

Title: Genomic study of the human salivary microbiome in patients with oral lichen planus

Authors: Tarun Mundluru, Andres Stucky, Mohammad Khalifeh, & Parish Sedghizadeh

Faculty advisor: Parish Sedghizadeh

Purpose: To conduct a genomic study assessing the salivary microbiome in patients with oral lichen planus. **Background:** Lichen planus is considered an autoimmune disease of unknown etiology. Recent data has implicated bacterial or viral infection as playing a role in the etiopathogenesis of lichen planus. In this study, we investi-

gate the oral microbiome in patients with active lichen planus as compared to healthy control patients without lichen planus. **Methods:** To investigate the relationship between lichen planus and oral microbiome status, we conducted DNA and RNA sequencing of human saliva and aligned it to both human and bacterial viral genomes. We collected saliva samples from three lichen planus cases and three naive controls. We performed an observational (clinical paired with genomic patient information) study to identify potential associations. **Results:** Over 1500 species of bacteria and viruses were identified in the salivary microbiome using DNA and RNA sequencing, with unique differences between patients with lichen planus and those without disease. We further characterize 10 predominant species associated with lichen planus as identified in this study. **Conclusion:** Certain bacterial and viral pathogens may play a role in the pathogenesis of oral lichen planus, thus knowledge of unique and predominant species is a necessary first-step for informing future studies into pathogenesis.

Poster #21

Title: A rare case presentation of adenomatoid odontogenic tumour with a novel treatment approach

Authors: Tarun Mundluru, D. Pilgrim, D. Kohanchi, J. El Khoury, Parish Sedghizadeh, & Reyes Enciso

Faculty advisor: Parish Sedghizadeh

Background: Adenomatoid odontogenic tumor (AOT) is an uncommon odontogenic tumor that originates from the odontogenic epithelium. It is predominantly noticed in young women, especially in the maxilla in association with an unerupted permanent tooth. Radiographic findings usually reveal a relatively well-defined radiolucency ranging from unilocular to multilocular; occasionally AOT can present as a mixed radiographic lesion. **Results:**

We are presenting a rare case report of AOT in a 60 year-old-male patient that presented with an asymptomatic mandibular swelling. This case report focuses on the relatively rare clinical, radiological, and histological manifestations of the case. Since the recurrence rate is low for AOT, enucleation was performed and the defect was treated with bone xenograft mixed with platelet-rich plasma and platelet-rich fibrin.

Poster #22

Title: Treatment of multiple gingival recession defects with VISTA: 2D analysis

Authors: Raffie Garabedian, Na Eun Chung, Robert Lacrampe, Neema Bakhshalian, & Homa H. Zadeh

Faculty advisor: Homa H. Zadeh

Background: Assessment of therapeutic efficacy for gingival recession defects has traditionally been conducted with periodontal probe and more recently, using 3D digital tools. It is desirable to determine the reliability of 2D methods of assessment, which are more widely available. **Purpose:** The objective of the present study was to first assess the reliability of using 2D analysis as a means to analyze the treatment of gingival recession defects. Once verified, the 2D analysis was then used to determine the outcome (primary: % surface area coverage=RSAC) of therapy for multiple gingival recession defects. **Methods:** Gingival Recession (GR) areas were measured using Adobe Photoshop on patients treated with Vestibular Incision Subperiosteal Tunnel Access (VISTA). Pre- and post-operative digital photographs were superimposed as separate layers. The surface areas of recession defects of pre- and post-op images were calculated, using image analysis tool. Four blinded examiners made quantitative digital measurements on clinical photographs. **Results:** Eighteen patients contributed 112 sites that met the inclusion/exclusion criteria.

The recession defects consisted of RT1 (N= 68) and RT2 (N=44). The mean RSAC at 1- and 4-year follow-up for RT1 were 135.77% + 68.96 and 126.63% + 93.79. The RSAC for RT2 at 1- and 4- year were 119.95% + 33.16 and 103.98% + 49.91 respectively. **Conclusion:** Multiple gingival recession defects were effectively treated with VISTA with RSAC values above 100%. Analysis of treatment outcomes using the simple 2D analysis method provided a useful and practical tool for research, which can be applied in future prospective studies.

Poster #23

Title: Effects of insertion speed and pre-drilling on orthodontic mini-implants

Authors: Yoon-Young Heo & Glenn T. Sameshima

Faculty advisor: Glenn T. Sameshima

Background: Excessive insertion torque during installation of orthodontic mini-implants (OMIs, temporary anchorage devices, or TADs) can cause overcompression of cortical bone and accumulation of microdamage and heat, resulting in premature loss of the OMI. Two ways to prevent excessive insertion torque are use of pre-drilling and a low drilling speed. **Purpose:** To investigate the effects of insertion speed and pre-drilling on the mechanical properties of OMIs. **Methods:** A total of 60 OMIs were allocated into 6 groups according to insertion speeds (30, 60, and 90 rpm) and pre-drilling (0 and 3.0 mm; pre-drilled with a drill-bit of 1 mm in diameter). The OMIs were installed in artificial bone blocks with two layers that simulated cortical bone and cancellous bone. After maximum insertion torque (MIT), total insertion energy (TIE), total insertion energy (TIE), peak time (PT), and TIE/PT were measured, Kruskal-Wallis test and Bonferroni correction were performed for statistical analysis. **Results:** Control-90 and Predrill-90 groups exhibited higher MIT than other groups [(Predrill-30, Predrill-60, Con-

trol-60)<(Predrill-60, Control-60, Control-30)<(Predrill-90, Control-90); P<0.001]. PT was decreased according to increase in the insertion speed [Predrill-90<(Control-90, Predrill-60)<Control-60<Predrill-30<Control-30; P<0.001]. TIE was proportionately increased according to increase in the insertion speed (rpm) [(Predrill-60, Predrill-30)<(Control-30, Control-60)<Predrill-90<Control-90, P<0.001]. All the pre-drilling groups had shorter PTs and lower TIEs than the corresponding control groups. TIE/PT was increased according to increase in the insertion speed [(Control-30, Predrill-30)<(Control-60, Predrill-60)<Control-90<Predrill-90; P<0.001]. **Conclusion:** Since the values of MIT, TIE and TIE/PT increased according to increase in the insertion speed, high insertion speed might accumulate microdamage even in pre-drilling groups.

DENTAL HYGIENE

Poster #24

Title: pHact or pHiction: oral and systemic benefits of alkaline water

Authors: Hayley Botwin, Clarice Lii, Denise Luna, & Melissa Luna

Faculty advisor: Joan Beleno Sanchez

Alkaline mineral water is defined as naturally occurring water with minerals, such as calcium and magnesium, and having a pH above 7. According to the World Health Organization (WHO), the optimum pH of drinking water should be between 6.5 to 9.5. Water pH is determined by mineral content, also known as total dissolved solids (TDS). Naturally occurring alkaline water is becoming increasingly popular worldwide as many pursue a healthier lifestyle through mindful food and beverage choices. Recent studies have shown that al-

kaline water benefits both the oral cavity and overall systemic health. People consuming water with a high level of TDS have shown a lower incidence of coronary heart disease (CHD) and cardiovascular disease (CVD). Frequent consumption of water is a common non-pharmacologic approach used to combat dry mouth and prevent erosion. People generally believe bottled water is safer than tap water, but the low pH of some bottled waters can be harmful. While slightly acidic water may not be problematic in healthy individuals, this study will reinforce the important role Dental Hygienists have in educating patients with dry mouth and providing safe recommendations. With an expanding consumption of bottled water, a growing elderly population suffering from xerostomia, and an increasing number of individuals with systemic diseases, investigation of the health benefits of alkaline mineral water deserves more attention.

Poster #25

Title: Matching organs, saving smiles: education for liver transplant patients

Authors: Joanne Lee

Faculty advisor: Joan Beleno Sanchez

Background: According to data from the United Network for Organ Sharing (UNOS), there were "36,527 organ transplants performed in the United States in 2018, [setting] an annual record for the sixth straight year." Increasingly more dental professionals are encountering liver transplant patients in the dental chair. While transplant surgery offers the gift of life, it also leads to the shift from end stage disease to chronic disease in the form of immunosuppression and other complications. To prevent rejection of the new liver, transplant recipients are prescribed immunosuppressive medications. There are multiple research studies that show the increased risks of dental decay, periodontal disease, and oral manifestations due to im-

munosuppressants. It is therefore vital for liver transplant patients to know about these increased risks and challenges to their oral health. **Purpose:** The purpose of this research is to gauge the awareness of liver transplant candidates/recipients to the importance of proper oral hygiene and their susceptibility to dental decay, periodontal disease, and oral manifestations due to immunosuppressants. **Methods:** A six-question survey was conducted in person at a local organ donation awareness event. **Results:** A total of 48 survey responses were recorded. 83.3% of those surveyed responded that they were not aware of the increased oral complications due to immunosuppressants, and 77.1% responded that they would like more information. **Conclusion:** Many transplant candidates/recipients are unaware of the possible oral complications due to immunosuppressants. Therefore, it is our responsibility as dental professionals to educate patients at our appointments and through interprofessional patient education opportunities.

Poster #26

Title: The hidden oral effects of juicing

Authors: Ryan Pham, So Yi Shin, Jacqueline Arceo, & Victoria Rondinella

Faculty advisor: Joan Beleno Sanchez

Background: Juicing using more fruits and vegetables has gained popularity as the preferred choice for nutrition. It is important for dental professionals to understand how the consumption of juices that may have systemic benefits may negatively affect one's oral health. Common acidic and sugary juices may affect enamel structures and also interact with the overall pH and microbiome within the oral cavity. **Purpose:** The purpose of this investigation was to identify the pH level of popular juice drinks and the ingredients that benefit both systemic and oral health. **Methods:** 4 Phases

were conducted: 1) Testing the pH level of 3 popular juices; 2) identifying ingredients of juices through a literature review; 3) identifying those ingredients with benefits for good for oral health (pH 6.8-7); and 4) Developing a juice based on the "good" ingredients yielding a pH of 6.8 and testing for taste by 2 independent raters. **Results:** The pH of 3 popular juices was below 6.2, however beneficial ingredients for good oral health within these juices included blueberries, apples, kales, carrots, and mint. Subsequently, a juice comprised of these ingredients was then formulated adjusting the amount of each ingredient to achieve a pH of 6.8 and an acceptable taste. **Conclusion:** It is possible to develop a juice that raises the pH to a beneficial level and tastes good. Dental professionals should be educated on how popular juicing habits may affect oral and systemic health as part of their nutritional counseling with patients.

Poster #27

Title: Regenerating PDL to rebuild optimal periodontal support

Authors: Mahdiah Kiany, Maryam Salarkia, & Narega Bargian

Faculty advisor: Joan Beleno Sanchez

Background: Periodontitis is an infectious disease that causes irreversible destruction of tooth-supporting tissues eventually leading to tooth loss. Periodontal inflammation has been successfully controlled through conventional therapies; however, the damage to the periodontium can be permanent and difficult to restore. **Purpose:** The aim of regenerating periodontal treatment is to establish the physiological function of teeth by rebuilding the periodontal supporting tissue. **Methods:** Different types of stem cells including mesenchymal stem cells (MSCs) and embryonic stem cells (ESCs) have been used for periodontal regeneration, among which MSCs had greater capabilities

and proliferation rate. MSC can be obtained from human periodontal ligament, using standard culture and proper growth factor. Properties of stem cells from the periodontal ligament (PDLSCs) are regulated by various factors including tissue origin, age of donor, culture method, inflammatory condition and growth factors to reach the optimum efficiency. **Results:** PDLSCs isolated from the alveolar socket of a young healthy donor were capable of forming cementum, PDL, and alveolar bone in vivo under certain conditions. **Conclusion:** Recent studies have utilized topical application of PDLSCs in vivo and successfully regenerated PDL, cementum and alveolar bone. This study will explore the possibility of regenerating the PDL, cementum, and bone and identifying the efficient condition and factors, to provide the effective periodontal treatment.

CBY/ PIBBS GRADUATE STUDENTS

Poster #28

Title: Bond strength to a novel CAD/CAM composite material

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

Faculty advisor: Jin-Ho Phark

Purpose: Part I: Evaluate the effect of different surface treatments on shear-bond strength (SBS) to a novel CAD/CAM composite. Part II: Compare the adhesive performance of six cements to two CAD/CAM composite materials. **Methods:** Two CAD/CAM materials (LuxaCam, DMG; Lava Ultimate, 3M) were tested SBS. Slices of 2mm thickness were cut and polished. Composite cylinders (microhybrid composite Z250, 3M) were bonded to the specimens. Half of each group were

tested after 24h water storage and the remaining after artificial aging by thermo-cycling (20K cycles, 5-55°C) and 6 months water storage. Notched edge SBS were measured and failure mode recorded. Part I: Adhesive performance of one CAD/CAM material (LuxaCam) was evaluated using different surface treatments (N=180). Part II: Adhesive performance of two CAD/CAM materials (N=330) were compared to each other using six cements (Universalzement, RelyX Ultimate, RelyX Unicem2, Multilink Automix, DuoCem, Ketac Cem Plus). **Results:** Part I: Early SBS was higher in sandblasted groups with no significant difference among them. After aging, group 1f (sandblasting and Monobond Plus) had the highest SBS values. Part II: Among the six cements, DuoCem performed best in early SBS for both materials. After aging, Universalzement ranked first for LuxaCam and second for Lava Ultimate. **Conclusion:** Micromechanical retention significantly improved the SBS to CAD/CAM composite materials. The choice of cement affected the bond strength.

Poster #29

Title: Role of FGFR2 during development of the posterior frontal suture

Authors: Lauren Bobzin & Amy Merrill

Faculty advisor: Amy Merrill

Background: Existing research into the formation of cranial sutures has uncovered the key role of Fgfr2 in regulating cellular differentiation and proliferation during development. Mutations resulting in gain of function of Fgfr2 have been shown to cause disorders such as Crouzon syndrome, which feature craniosynostosis as a prominent phenotype. Preliminary data in our lab shows that ablation of Fgfr2 within neural crest derived tissue results in patency of the PF suture and a loss of the cartilage that normally forms its endochondral template. Whether this defect is caused by disrupted cellular

proliferation, differentiation, or another mechanism is not currently clear. **Methods:** By using a combination of histological, immunocytochemical, and sequencing techniques we will examine the effect of loss of Fgfr2 on cell fate choice, suture joint space establishment and maintenance, and expression of genes known to be associated with cranial suture morphogenesis and osteoblast differentiation. The unique nature of the neural crest derived, endochondrally fused PF suture provides a distinctive opportunity to expand our knowledge pertaining to cranial suture development, and thereby improve the quality of treatment available to patients suffering from suture defects. Completion of this study will result in greatly increased understanding of the role of Fgfr2 during suture development and contextualizing this role both spatiotemporally and epistatically.

Poster #30

Title: Cranial pericytes derived from neural crest cells reveal a pericyte-specific functional defect in Alzheimer's disease

Authors: Casey Griffin & Ruchi Bajpai

Faculty advisor: Ruchi Bajpai

Background: Defects in or loss of functional forebrain pericytes leads to breakdown of the integrity of the blood brain barrier (BBB), causing leakage of toxins and pathogens into the brain and compromising the immune-privileged state of the brain. Leakiness of the BBB has recently been found to play a part in numerous neurodegenerative diseases, most notably Alzheimer's disease (AD). **Purpose:** My project focuses on understanding what defines forebrain pericytes as a unique pericyte population, with emphasis on their developmental source as well as their transcriptome and epigenome architecture, and the changes in these aspects associated with disease. **Methods:** I have developed a system of generating forebrain pericytes from neural crest cells in vitro. I have characterized these cells

functionally and transcriptomically, comparing to primary brain pericytes across different species. I have also generated pericytes from AD patient cells and compared these to primary patient pericytes and controls to begin to characterize the pericyte-specific defects in AD. **Results:** I have identified pericyte defects that are common across different patients and mutations of AD, honing in on possible general pathways important to pericyte function at the BBB. I have also shown that the in vitro system I created is able to recapitulate in vivo conditions in both the wild type state and the disease state when compared to both primary human and primary rat samples. **Conclusion:** My in vitro method of generating forebrain pericytes is able to provide insights into the roles pericytes play in development and maintenance of the BBB, as well as the mechanisms of various defects associated with disease. This system can be used to study pericytes of different AD mutations, as well as be applied to other diseases involving pericytes, such as ALS and Parkinson's.

Poster #31

Title: Quantitative light-induced fluorescence for visualization and quantification of coronal dentin mineral density.

Authors: Garima Sandhu, Amrita Chakraborty, & Janet Moradian-Oldak

Faculty advisor: Janet Moradian-Oldak

Background: QLF has been routinely employed to study enamel defects, especially white spot lesions on teeth. Utilization of sodium fluorescein dye and QLF to monitor de- and re-mineralization of root dentin has also been recently reported (I.A. Pretty et al., 2003). **Purpose:** To employ QLF to quantify the changes in fluorescence of coronal dentin when subjected to demineralization and remineralization in the presence of amelogenin derived peptide (P26). P26 has been shown to be effective

in growing enamel like apatite crystals on etched enamel surface (Mukherjee et al., 2017).

Methods: Cross-sections (1.5mm thickness) of extracted mandibular third molars were used. Two windows measuring 1 mm x 1mm were created on every section using clear varnish and were examined under QLF for generating baseline values. Samples were demineralized for 72 hours and analyzed under QLF at intervals of 12, 48 and 72 hours. Samples were split into half, one half was used as an internal control being remineralized in artificial saliva, and the other half being remineralized in the presence of P26. Sodium fluorescein dye was used at every step of analysis to complement visualization under QLF. **Results:** Gradual loss in fluorescence of dentin with respect to baseline values was observed during demineralization and the reverse was seen after remineralization. Percentage loss in fluorescence (ΔF) was used for quantification of data. The results are in agreement with the results from Micro-CT. **Conclusion:** We conclude that QLF can be employed to study changes in dentin and be quantified for better understanding of remineralization process.

Poster #32

Title: Comprehensive analysis of dental cell types during molar formation

Authors: Jiahui Du, Junjun Jing, & Yang Chai

Faculty advisor: Yang Chai

Background: The understanding of the heterogeneity of cell populations in a particular organ can provide comprehensive information about the mechanism regulating the physiological function of the organ. The heterogeneity of dental cell populations during molar development is unknown. **Purpose:** We aim to identify the heterogeneity of dental cell populations during molar development. **Methods:** Mouse molars of wildtype mice at E16.5 and PN3.5 were dissected and were homogenized into sin-

gle cell suspension. The single cell RNA sequencing was performed with Nextseq500 system and the reads were aligned with Cell Ranger. We used Seurat package implemented in R to identify major cell types in mouse molars. Immunostaining and RNAscope in situ hybridization analysis were performed to validate the gene expression. **Results:** We have revealed several new cell types in the mesenchyme and epithelium of mouse molars. Specifically, there are four cell populations in the dental papilla and two cell populations in the dental follicle of mouse molars at PN3.5. Importantly, the differentiation trajectory of dental papilla cells initiates at the apical region of mouse molars at PN3.5. Furthermore, we also found that Igf signaling is active in mouse molars at PN3.5. In addition, dental mesenchymal cells gradually restrict into unique cell populations at PN3.5. **Conclusion:** Our study provides comprehensive information about the heterogeneity of cell populations in mouse molars and shed new light on the tooth regeneration in the future.

Poster #33

Title: Amelogenin peptide-collagen interactions and dentin repair

Authors: Kaushik Mukherjee, Gayathri Visakan, & Janet Moradian-Oldak

Faculty advisor: Janet Moradian-Oldak

Purpose: To investigate role of amelogenin-peptide (P26) in regulating i) the mineralization of collagen fibers in vitro and ii) the growth of hydroxyapatite (HAP) crystals on a demineralized dentin surface. **Background:** Interactions and assembly of enamel and dentin proteins at the dentin-enamel junction (DEJ) regulate the growth of organized enamel crystals, forming a robust interface. **Methods:** Type I collagen was mixed with PBS to obtain 1mg/ml collagen solution in 1XPBS at pH 7. Assembled collagen fibers on TEM grids were

immersed in i) P26 (0.2mg/ml; 2% uranyl acetate stain) and in ii) CaP solution with and without P26. The collagen-peptide interactions, their assembly and mineralization events were observed under TEM. Human molars were transversally sectioned into 2mm slices and immersed in a demineralizing solution. P26 was applied on dentin slices on days 1 and 5 and incubated in artificial saliva for 10 days. Crystal morphology and orientation of the remineralized layers were observed using SEM and XRD. **Results:** Negatively-stained collagen assembled into fibers showing a characteristic banding pattern under TEM. Addition of P26 displayed distinct spherical assemblies closely aligned with the collagen fibrils. Mineralization in the presence of P26 and collagen resulted in the formation of amorphous calcium phosphate and small HAP crystallites that were densely attached to the fibril surface. Dentin slices treated in P26 showed occluded surface tubules and a dense coating of newly formed HAP crystals seen under SEM and XRD. **Conclusion:** P26 interacts with collagen fibrils promoting surface mineralization in vitro and facilitates remineralization of exposed dentin.

Poster #34

Title: Regulation of 3D genome re-organization during cell fate transition

Authors: Kaivalya Shevade & Ruchi Bajpai

Faculty advisor: Ruchi Bajpai

Background: 3D genome re-organizes when normal cells switch fate, respond to stimuli, undergo senescence etc. Yet, real time visualization of genome reorganization has remained a challenge. **Methods:** We used Neural Crest Cell (NCC) to Ectomesenchymal Cell (EMC) transition as a model to study the genome organization changes that happen during differentiation. **Results:** When induced to differentiate rapidly proliferating NCCs transiently exit the cell cycle and

homogenously differentiate to ectomesenchymal cells over a period of 96hr. After 96hr of differentiation the genome of NCCs gets organized into DAPI dense and less dense regions and all chromosomes become compact. Nuclei of NCCs undergo a 3-5 times volume expansion within the first 20hr of differentiation during which massive chromatin redistribution occurs and majority of the new DNA-DNA contacts are already established. This is followed by formation of multi lobed nuclei which are rapidly resolved in the final stages of the transition to reform the spherical nucleus. Nuclear expansion occurs without an increase in transposon accessible DNA sites. CHD7, a chromatin remodeling protein to be necessary for large scale genomic restructuring. 75% knockdown of CHD7 mediated by shRNA completely inhibits the nuclear expansion and the subsequent ectomesenchymal transition. Cells with CHD7 haploinsufficiency derived from CHARGE patients show a similar defect in the nuclear expansion followed by inability to upregulate key mesenchymal genes. **Conclusion:** We for the first time, have identified a cellular transition during normal development where 3D genome reorganization occurs and have also discovered that a chromatin remodeler is necessary for this 3D genome re-organization.

Poster #35

Title: Role of Runx2 arginine methylation in functional interaction with BMP-Smad pathway

Authors: Prerna Sehgal, Yongchao Gou, 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 incomplete mineralization of the skeleton. Because of its importance, Runx2 is tightly regulated by signaling pathways such as BMP and post-trans-

lational modifications to control its activity and expression. Our lab revealed novel methylation of Runx2 by protein arginine methyltransferases (PRMTs). Our Preliminary data shows that PRMT3 and 4 are highly expressed in the osteoblast lineages and catalyze Runx2 methylation at 4 arginine (R) residues 244, 253, 372 and 377. Sites R372 and R377 encompass Smad-binding suggesting its role in BMP-induced osteogenesis. **Purpose:** My project is centered around understanding the role of Runx2 arginine methylation in osteogenesis. **Methods:** I am using an in vitro system to examine the interaction between Runx2 and Smad1 which will be further validated in cultured cells. As the most prominent function of protein methylation is to control protein-protein interactions, I will profile the major binding partners involved in modulating Runx2 activity and signaling response, and further characterize the role of these players in osteogenic differentiation. **Results:** I anticipate that methylation of sites R372/R377 is required for interaction between Runx2 and Smad1 and this complex plays a role in driving osteogenesis. Runx2 has been known to bind to C/EBPs, HPs, and p300 via the TD domain, which harbors the methylation sites and I expect these to come up during binding partners profiling. **Conclusion:** Experiments are underway to investigate the role of Runx2 methylation in osteogenesis.

Poster #36

Title: Amelogenin ameloblastin interaction in developing enamel matrix

Authors: Rucha Arun Bapat, Jingtian Su, Scott Barlow, & Janet Moradian-Oldak

Faculty advisor: Janet Moradian-Oldak

Background: Enamel matrix proteins amelogenin (Amel) and ameloblastin (Ambn) colocalize in the secretory stage and their fragments continue to colocalize in the maturation stage of enamel formation. Ad-

dition of Ambn changes Amel secondary structure in-vitro, suggesting molecular interactions. However, evidence of direct interactions between Amel and Ambn in enamel formation remains scarce. **Purpose:** To test the hypothesis that amelogenin and ameloblastin interact during enamel development. **Methods:** In-vivo colocalization patterns between Amel-Ambn were observed through immunohistochemical labeling in 5-day-old mouse incisors and quantified with Leica SP8 confocal microscope. To show direct interaction and to identify the domain of Ambn binding to Amel, Pierce coimmunoprecipitation (co-IP) kit was used. Co-IP between recombinant amelogenin and WT Ambn, 2 Ambn mutants lacking exon 5 and exon 6 sequences, and various Ambn peptides was analyzed using Western Blots. Results of the recombinant protein co-IPs were confirmed with native extract of porcine enamel matrix proteins. **Results:** Amel and Ambn colocalize within ameloblasts and at the Tomes' processes in developing mouse incisor. The sequence encoded by exon 5 of Ambn, specifically its N terminal fragment binds to Amel. Native Amel and Ambn interact within in-vivo extract of enamel matrix proteins from porcine second molar. **Conclusion:** We have demonstrated direct Amel-Ambn binding in-vitro between recombinant proteins and in porcine native protein extract suggesting that they play a cooperative role during enamel formation. Together they may be controlling mineralization and maintaining enamel prism architecture.

Poster #37

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

Authors: Sara Elhusseini, Ahmed Sharaf, Jassem Alsharrah, & Homa H. Zadeh

Faculty advisor: Homa H. Zadeh

Background: Dimensional changes of the alveolar ridge

crest following tooth extraction have been extensively studied. However, post extraction changes in the maxillary sinus floor have not been investigated. The aim of the present retrospective study was to explore changes to the maxillary sinus floor using 3D volumetric analysis. **Methods:** 24 Pre- and post-operative CBCTs of 24 individuals who had maxillary molar tooth extraction at USC Ostrow School of Dentistry were included in this study. The CBCT images were imported into 3D software Called AMIRA . Pre- and post-operative CBCTs studies were segmented so that discreet volumes of the maxillary sinus and the alveolar ridge were created. The volumes of the pre-op and post-op sinus and alveolar ridge were oriented and superimposed. Cross sections were made perpendicular to the curvature of the maxillary arch in the center of each extracted tooth. These superimposed pre-op and post-op images were utilized for two-dimensional analysis of the sinus floor changes. **Results:** Examination of representative superimposed pre-op and post-op CBCT images revealed very little change in the position of the maxillary sinus floor following tooth extraction and significant dimensional changes in the alveolar ridge. This is consistent with linear measurements from 2D images reported by Hameed, et al., who have observed that the mean sinus floor vertical height changes were 0.62, 0.37, 0.4mm and the mean crestal bone height changes were 3.07, 3.33 and 2.99 in the sites of MB, DB and P P maxillary molar roots, respectively. Linear measurements of superimposed pre-op and post-op CBCT 3D revealed that the sinus floor changes are 0.10 mm in a superior position. **Conclusion:** Proof of principle pilot analysis demonstrated feasibility of superimposing pre- and post-extraction alveolar crest and maxillary sinus. Maxillary sinus floor position at pre- and post-extraction showed no positional change 97.2 % of the measured sites. Alveolar crest exhibited severe horizontal and vertical atrophy.

Poster #38

Title: Protein arginine methyltransferase 1 regulates MSX-1 methylation

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

Faculty advisor: Jian Xu

Background: Protein Arginine Methyltransferase 1 (PRMT1) is an enzyme required for the majority of arginine methylation in our body. Previous studies in our lab have shown that cranial neural crest-specific Prmt1 deletion mice exhibit cleft palate with 100% penetrance and defects in alveolar bone and incisors, which phenocopied mutation of Msx-1, a transcription factor essential for craniofacial development. Therefore, PRMT1 was proposed to regulate craniofacial development upstream of MSX-1. We further demonstrated a moderate decrease in Msx-1 mRNA expression upon Prmt1 deletion, suggesting post-transcriptional mechanisms by which PRMT1 controls MSX-1 activity. We hypothesize that PRMT1 controls MSX-1 activity through arginine methylation. **Purpose:** We aim to investigate PRMT1-mediated MSX-1 methylation and its functional significance. **Methods:** Immunoprecipitation and western blotting were performed to investigate PRMT1 - MSX-1 interaction and potential methylation sites in vivo with 293T cells. Methylation of MSX-1 by PRMT1 was further verified with in vivo methylation method. **Results:** We found that PRMT1 interacts with MSX-1 and methylates MSX-1. Mutation at two predicted methylation sites, R150 and R157, significantly altered MSX-1 interaction with PRMT1. **Conclusion:** Our data show that PRMT1 regulates MSX-1 methylation via two potential sites, R150 and R157.



Poster #39

Title: Remineralization of demineralized dentin by amelogenin peptide P26

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

Faculty advisor: Janet Moradian-Oldak

Purpose: To test the hypothesis that treating partially demineralized dentin with P26 peptide results in recovery of physical properties, and mineral density gain. **Background:** Non-Carious Cervical lesions result from mechanical and chemical insult to the enamel leading to dentinal exposure. Dentin owing to its heterogenous composition poses a restorative challenge. Furthermore, the cervical dentin is under compressive, and tensile stresses resulting from centric, and eccentric occlusal forces. We have previously demonstrated the ability of amelogenin inspired synthetic peptides in promoting the re-growth of aprismatic enamel like layer on etched enamel surface (Mukherjee et al., 2017). **Methods:** Extracted human third molars were cross-sectioned to obtain dentin slices from the superficial, and middle dentin regions. The sectioned teeth were divided into 4 groups corresponding to normal dentin, demineralized dentin, P26 treatment, and control. For micro-tensile strength testing hour-glass shaped test specimens, were tested under tension (Instron 5965, 0.5mm/min) until fracture. Bone mineral density was calculated using a commercial micro-CT system (SkyScan 1174) after calibration with hydroxyapatite phantoms. Scanning electron microscopy and EDAX were used to characterize the effect of P26 treatment. **Results:** Following 10 days of remineralization in artificial saliva, P26 treatment resulted in a 53.24% recovery in tensile strength with respect to normal dentin, and bone mineral density gain of 9.93% from that of demineralized dentin (n=10). Dentinal tubular occlusion and mineral deposition on dentin collagen fibers was observed. **Conclu-**

sion: P26 treatment of partially demineralized dentin leads to partial recovery of tensile strength, and enhancement of mineral density.

Poster #40

Title: Understanding the function of a novel histone binding protein in development

Authors: Yuhan Sun & Susan Smith

Faculty advisor: Ruchi Bajpai

Purpose: To understand the function of the PHF6 protein during embryonic development. **Background:** Patients with Borjeson Forssman Lehmann Syndrome (BFLS) have many phenotypes (hyperpigmentation and hypodontia) occur in neural crest-derived cells. NCCs is known differentiating from the neural plate and going to migrate out and form many other types of cells. What's the role of PHF6 in this process is not known yet. In PHF6 there are two ePHD domains. Previous studies have shown that the second ePHD domain binds to the dsDNA non-specifically. However, what's the function of the first ePHD domain is not known yet. **Methods:** BFLS patient NCCs was induced in our lab in vitro to do the differentiation experiments. Co-IP was done to find out the binding partner of the PHF6 protein. CRISPR Cas9 protein, guide RNA and a ssDNA template were co-injected into zebrafish embryos to create disease model. **Results:** We showed that when knock-down PHF6, accelerated differentiations were observed in multiple contexts, including the NCC formation and differentiation. In vitro, PHF6 protein can bind to K4Me and citrullinated 8 (cit8) double modified histone3 through the first ePHD. In vivo, the phf6 mutant fish are generated and to be analysis. **Conclusions:** PHF6 protein may have a function in inhibit the differentiation in many different concepts. This function may be conduct through PHF6's ability of binding to H3-K4Me and H3-Cit8.

DENTISTRY/ CCMB POSTDOCTORAL FELLOWS

Poster #41

Title: Detection of human papillomavirus in cases of head and neck squamous cell carcinoma by RNA-seq and VirTect

Authors: Andres Stucky, Xuelian Chen, Atlas Khan, Qian Liu, Parish Sedghizadeh, Daniel Adelpour, Xi Zhang, Kai Wang, & Jiang F. Zhong

Faculty advisor: Jiang F. Zhong

Background: Next generation sequencing (NGS) provides an opportunity to detect viral species from RNA-seq data of human tissues, but existing computational approaches do not perform optimally on clinical samples. **Methods:** We developed a bioinformatics method called VirTect for detecting viruses in neoplastic human tissues using RNA-seq data. Here, we used VirTect to analyze RNA-seq data from 363 HNSCC (head and neck squamous cell carcinoma) patients and identified 22 human papillomavirus (HPV)-induced HNSCCs. These predictions were validated by manual review of pathology reports on histopathologic specimens. **Results:** VirTect showed better performance in recall and accuracy compared to the two existing prediction methods VirusFinder and VirusSeq, in identifying viral sequences from RNA-seq data. The majority of HPV carcinogenesis studies thus far have been performed on cervical cancer and generalized to HNSCC. **Conclusion:** Our results suggest that carcinogenesis of HPV-induced HNSCC and other cases of HNSCC involve different genes, so understanding the underlying molecular mechanisms will have a significant impact on therapeutic approaches and outcomes. In summary,

RNA-seq together with VirTect can be an effective solution for the detection of viruses from tumor samples and can facilitate the clinicopathologic characterization of various types of cancers with broad applications for oncology.

Poster #42

Title: BMP signaling in regulating mesenchymal stem cells in incisor homeostasis

Authors: Congchong Shi, Yuan Yuan, Yuxing Guo, Junjun Jing, Thach-Vu Ho, Xia Han, Jingyuan Li, Jifan Feng, & Yang Chai

Faculty advisor: Yang Chai

Background: Bone morphogenetic protein (BMP) signaling performs multiple essential functions during craniofacial development. **Methods:** In this study, we used the adult mouse incisor as a model to uncover how BMP signaling maintains tissue homeostasis and regulates mesenchymal stem cell (MSC) fate by mediating WNT and FGF signaling. **Results:** We observed a severe defect in the proximal region of the adult mouse incisor after loss of BMP signaling in the Gli1+ cell lineage, indicating that BMP signaling is required for cell proliferation and odontoblast differentiation. **Conclusion:** Our study demonstrated that BMP signaling serves as a key regulator that antagonizes WNT and FGF signaling to regulate MSC lineage commitment. In addition, BMP signaling in the Gli1+ cell lineage is also required for the maintenance of quiescent MSCs, suggesting that BMP signaling is not only important for odontoblast differentiation but also plays a crucial role in providing feedback to the MSC population. This study highlights multiple important roles of BMP signaling in regulating tissue homeostasis.



Poster #43

Title: Signaling network regulating soft palatal muscle development

Authors: Eva Janečková, Xia Han, Jifan Feng, Jingyuan Li, & Yang Chai

Faculty advisor: Yang Chai

Background: Cleft lip and/or palate is one of the most common birth defects in humans and necessitates extensive medical intervention. Substantial research has focused on hard palate development; however, little is known about the molecular signaling in the soft palate. The surgical correction of cleft soft palate is very challenging as it involves extensive repair of musculature.

Purpose: The objective of our investigation is to analyze the molecular signaling involved in soft palate development, focusing on Wnt and Tgf- β signaling as well as interactions between cranial neural crest (CNC) and mesoderm-derived cells during this process. **Methods:** RNAscope, immunofluorescence, histologic analyses of conditional knock-out mice *Osr2-Cre; β -catenin^{fl/fl}*, *Osr2-Cre; β -catenin^{exon-3fl/+}*, *Osr2-Cre; Tgfb2^{fl/fl}* and LacZ reporter mice. **Results:** The expression of Wnt and Tgf- β signaling was identified in the soft palatal myogenic sites, specifically in mesenchymal cells of CNC origin and myogenic cells of cranial mesoderm origin. After conditionally deleting or over-activating β -catenin and Tgfb2 specifically in the CNC-derived mesenchyme using *Osr2-Cre*, severe changes in soft palatal muscles were observed. **Conclusion:** Our results highlight the importance of Wnt and Tgf- β signaling during soft palate development and suggest the significance of the interaction between the CNC-derived mesenchyme and myogenic cells as well as the necessity of strict regulation of Wnt expression levels during soft palate development. Detailed understanding of the signaling pathways involved in soft palate development and associated cell-cell interactions may contribute to more suc-

cessful surgery and improved treatment of cleft soft palate.

Poster #44

Title: Interferon-independent antiviral activity of MAVS via the regulation of mitochondrial dynamics.

Authors: Jessica Carriere, Junjie Zhang, Mao Tian, Huichao Huang, Shu Zhang, Xiaoxi Lin, Arlet Minassian, & Pinghui Feng

Faculty advisor: Pinghui Feng

Background: The mitochondrion antiviral signaling (MAVS) molecule relays dsRNA-induced RIG-I/MDA5 activation to IKK α/β and TBK-1/IKK ϵ that enable NF- κ B- and IRF3-mediated transcriptional up-regulation, respectively. Central to the RIG-I/MAVS antiviral pathway is the CARD-mediated oligomerization at the mitochondrion. **Results:** We report here that two CARD-less variants of MAVS, i.e., MAVS40 and MAVS30, demonstrate intrinsic antiviral activity against herpesviruses. Biochemical analysis indicated that MAVS40 and MAVS30 were produced by a combination of proteolytic cleavage and internal translation. Lacking the CARD domain, MAVS40 and MAVS30 exerted activity to impede the traffic of herpesviral capsids into the nucleus. Consistent with this, affinity purification and mass spectrometry identified multiple viral structural (tegument and capsid) proteins interacting with these CARD-less MAVS. Further cell biological analyses using immunofluorescence, immunogold labeling and electron microscopy indicated that MAVS isoforms were essential to induce an elongation of the mitochondrial network and the docking of herpes virions on the mitochondria, preventing them to pursue the viral replication cycle. Further investigation revealed that the MAVS-mediated elongation of the mitochondria was associated with a nuclear translocation of the fission factor DRP1, decreasing the available pool of DRP1 in the cytoplasm to induce mitochondrial fission.

We also found evidence that DRP1 underwent a TBK-1/IK- κ -mediated phosphorylation triggering the translocation into the nucleus. **Conclusion:** Taken together, our findings will define an intrinsic antiviral activity of MAVS in host immune defense through the inhibition of mitochondrial fission via the phosphorylation-dependent nuclear translocation of the fission factor DRP1, resulting in a mitochondrial elongation and the docking of virions on the mitochondrial membrane.

Poster #45

Title: Cardiac myofibroblast-specific deletion of protein arginine methyltransferase 1 (PRMT1) protects against TAC-induced ventricular remodeling and dysfunction

Authors: Jiang Qian, Olan Jackson-Weaver, Jian Wu, Aesha Upadhyay, Sok Ung, & Jian Xu

Faculty advisor: Jian Xu

Purpose: To define the *in vivo* roles of PRMT1 in regulating the fate conversion of cardiac fibroblasts to myofibroblasts in chronic stressed hearts. **Background:** Cardiac fibroblast and its programmed conversion into activated myofibroblasts are critical contributors in myocardial extracellular matrix (ECM) homeostasis during injuries. Our lab recently identified the protein arginine methyltransferase 1 (PRMT1) as a new *in vitro* regulatory mechanism for cardiac fibroblasts differentiate to myofibroblasts. However, the *in vivo* function of PRMT1 in the heart is not clear. **Methods:** We generated an inducible myofibroblast-specific *Prmt1* knockout mouse model (*Pn^{MCM}/+;Prmt1^{flox/flox}:R26R^{YFP/YFP}*), in which the myofibroblastic *Prmt1* expression within the injured heart is inhibited by the activation of Perionstin-Cre. Cardiac injury was induced by TAC surgery in *Prmt1* deletion (*PnMCM/+;Prmt1^{flox/flox}:R-26RYFP/YFP*) and non-deletion (*Prmt1^{flox/flox}:R26R^{YFP/YFP}*) mice to mimic the hypertrophy-related remodeling and dysfunction. Sham surgery

was performed in both lines as controls. **Results:** Deletion of PRMT1 in cardiac myofibroblasts prevented the myofibroblasts differentiation, decreased cardiac fibrosis, increased the vessel density and preserved the ventricular function after 8w TAC, compared with controls.

Poster #46

Title: RUNX2 arginine methylation regulates the response to TGF- β in breast cancer cells

Authors: Jian Qin, Yongchao Gou, Baruch Frenkel, Michael Stallcup, & Jian Xu

Faculty advisor: Jian Xu

Purpose: Inhibition of Runx2 arginine methylation regulates its function in breast cancer cell. **Background:** Runx2 is an important transcription factor that regulates mammary gland development, mammary cancer and bone metastasis of multiple types of cancer. Our previous research revealed that Runx2 can be methylation at arginine 244, 253, 372 and 377 by protein arginine methyltransferase PRMT4 and affect migration and invasion in mammary cell. **Methods:** Cell culture, western blots, mutagenesis, stable cell line generation, immunoprecipitation, real time-PCR. **Results:** The methylation level of endogenous RUNX2 was reduced when PRMT4 level was knockdown in mammary epithelial cells. To understand the function of RUNX2 methylation, we mutated its arginine (R) 244, 253, 372 and 377 into lysine (K), R4K. RUNX2 can interact with both SMAD3 and p-SMAD3, meanwhile the binding ability was weaker in RUNX2 R4K mutant compared with wildtype. We generate NMuMG stable cells that overexpress wildtype or R4K RUNX2 and found the expression level of TGF- β target genes in mammary cell lines was lower in RUNX2 R4K mutant group compared with the wildtype group. In MDA-MB-231 stable cell lines, the baseline expression of TGF- β -target genes *Serpine* and *PTHrP* were lower in the

RUNX2 R4K group, and their response to the TGF- β stimulation were dampened. **Conclusions:** Endogenous RUNX2 can be methylated by PRMT4 in mammary cells. RUNX2 can interact with both SMAD3 and p-SMAD. The inhibition of RUNX2 methylation can suppress its interaction with SMAD3. Inhibition of RUNX2 methylation can reduce the response to TGF- β treatment in breast cancer cells.

Poster #47

Title: Molecular regulatory mechanisms of soft palate development

Authors: Jifan Feng, Yuan Yuan, Xia Han, Eva Janečková, & Yang Chai

Faculty advisor: Yang Chai

Background: The coordinated movements of the soft palate and pharyngeal muscles are crucial for speech, swallowing, breathing and hearing. Our previous studies suggested that cranial neural crest (CNC)-derived cells migrate into the primordium of multiple myogenic sites in the craniofacial region, and are in close contact with myogenic cells at later stages. Tissue-specific ablation of the TGF- β signaling pathway in CNC-derived cells leads to defects in the proliferation, patterning, and differentiation of myogenic cells in the tongue and other craniofacial muscles. Therefore, we hypothesized CNC-derived cells regulates soft palate myogenesis through tissue-tissue interaction. **Purpose:** The aim of this study is to understand the molecular mechanisms controlling soft palate muscle formation for better repair of soft palate defects. **Methods:** RNA sequence analysis was performed to compare gene-expression profile of E14.5 *Osr2-Cre;Alk5^{fl/fl}* and control soft palate. Single cell RNA-sequence analysis was performed to identify signaling molecules that are enriched in the E14.5 soft palate CNC-derived cells. **Results:** We identified several significantly altered cluster markers and signaling molecules in CNC-derived

cells in E14.5 *Osr2-Cre;Alk5^{fl/fl}* mouse soft palate. We are currently testing the function of these altered downstream targets in regulating soft palate myogenesis. **Conclusions:** TGF- β signaling pathway may regulate the key signaling molecules produced by CNC-derived cells to regulate soft palate muscle formation.

Poster #48

Title: Ameloblastin-cell interaction is mediated by an evolutionary conserved amphipathic helix within exon 5

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

Faculty advisor: Janet Moradian-Oldak

Background: In biomineralizing systems, cell-matrix adhesion allows cells to physically organize three-dimensional extracellular matrix (ECM) to direct the deposition of highly ordered mineral structures. This process is commonly mediated by integrin receptors for ECM proteins including collagens and non-collagenous proteins in bone and dentin. While it is known that enamel has a distinct set of ECM proteins, enamel cell-matrix adhesion has thus far remained enigmatic. **Methods:** Here, applied high-resolution confocal microscopy to mouse mandibular tissues to show co-localization between mouse Ambn and membrane surfaces. **Results:** Using recombinant Ambn and a series of Ambn derived synthetic peptides we show that Ambn binds to cell membrane through an amino acid motif located at the N-terminal of the sequence encoded by exon 5. A mutant recombinant Ambn protein lacking the sequences encoded by exon five lost its ability to bind to LS8 ameloblast-like cell membrane. A systematic analysis of Ambn sequence using Helixquest revealed that the cell-binding motif has a potential to form an amphipathic helix. Remarkably, the amino acid sequences that form this amphipathic helix are evolutionary conserved across the mam-

malian species with prismatic enamel, but are not present in mammalian or non-mammalian vertebrates without prismatic enamel. We introduce fundamental principles of enamel cell-matrix adhesion during amelogenesis and propose a molecular mechanism underlying the transition from non-prismatic to prismatic enamel that occurred in the mammalian lineage.

Poster #49

Title: Lhx6 is required for root furcation formation in molars

Authors: Jinzhi He, Hua Tian, Jifan Feng, Yuan Yuan, Junjun Jing, & Yang Chai

Faculty advisor: Yang Chai

Background: LIM-homeobox containing (Lhx) genes encode transcriptional regulators that play critical roles in patterning and differentiation in craniofacial organogenesis. Previous study shows that *Lhx6* and *Lhx8* double knockout mice exhibit cleft palate and molar agenesis. However, little is known about the function of Lhx6 in tooth root development. **Purpose:** To explore the underlying mechanisms how Lhx6 controls root number by influencing the furcation formation. **Methods:** Both *Lhx6-Cre^{ERT2}* homozygous mice (The *Lhx6-Cre^{ERT2}* knock-in allele in these mice abolishes *Lhx6* expression) and *Lhx6-Cre^{ERT2};tdTomato* mice were used in present study. We performed in situ hybridization to analyze the expression pattern of Lhx6 at different postnatal stages during tooth root development. We analyzed the phenotypes using microCT and histology. Moreover, we did immunofluorescent staining to investigate possible mechanisms. **Results:** We found that Lhx6 expression is detectable both in odontoblasts and the mesenchymal cells of the dental papilla and dental follicle during root development postnatally. Lineage tracing analysis shows that Lhx6 positive cells contribute to odontoblasts, alveolar bone and periodontal ligament cells. Loss of Lhx6 resulted in no furcation

formation in the tooth molar even at postnatal stage 21.5 (PN 21.5). In addition, Lhx6 mutation resulted in delayed epithelial protrusion contact and dentine protrusion elongation, compromised odontoblast differentiation, and increased cell proliferation at the furcation site. However, apoptosis were unaffected. **Conclusion:** Our results demonstrate that Lhx6 is critical for root furcation formation likely via regulation of proliferation.

Poster #50

Title: A purine synthesis enzyme impedes nuclear import of gamma-herpes viral RTA via deamidation

Authors: Junhua Li, Simin Xu, Jun Zhao, Junjie Zhang, Jun Xiao, Mao Tian, Yi Zeng, Katie Lee, Vera Tarakanova, Hao Feng & Pinghui Feng

Faculty advisor: Pinghui Feng

Protein function is chiefly regulated via post-translational modifications. Deamidation is emerging as a key regulatory mechanism governing protein function yet its roles in fundamental biology remain poorly defined. Here we report that a cellular purine synthesis enzyme inhibits protein nuclear import via deamidation. To probe the role of protein deamidation in biological processes, we performed a focused screen for cellular glutamine amidotransferases that restrict lytic replication of human Kaposi's sarcoma-associated herpesvirus (KSHV). This identified a purine synthesis enzyme, phosphoribosylformyl-glycinamide synthetase (PFAS) that inhibits KSHV transcriptional activation. Biochemical assays indicate that PFAS deamidates the replication transactivator (RTA), a transcription factor crucial for KSHV lytic replication. Mechanistically, deamidation of two asparagines flanking a classic nuclear localization signal impaired the binding of RTA to the importin complex, a molecular shuttle to the nuclear compartment, thus diminishing RTA nuclear localization

and transcriptional activation. Finally, nuclear import of RTA proteins of all gamma herpesviruses appears to be regulated by PFAS-mediated deamidation. These findings uncover an unexpected function of a metabolic enzyme in restricting viral replication and a key role of deamidation in regulating protein nuclear import, expanding the functional repertoire of protein deamidation in fundamental biological processes.

Poster #51

Title: Antagonistic interaction between Ezh2 and Arid1a coordinates dental root patterning via Cdkn2a

Authors: Junjun Jing & Yang Chai

Faculty advisor: Yang Chai

Background: EZH2 is a key component of polycomb repressive complex 2 (PRC2), which is responsible for Histone 3 Lysine 27 trimethylation (H3K27Me3). Ezh2 is required for neural crest derived cartilage and bone formation. However, the role of Ezh2 in tooth development is unknown. **Purpose:** We aim to elucidate the role of Ezh2 in molar development and its function in patterning the tooth furcation. **Methods:** Multiple transgenic mouse models were generated in this study: *Osr2KI-Cre;Ezh2^{fl/fl}*, in which *Ezh2* expression is lost in the tooth mesenchyme; *DMP1-Cre;Ezh2^{fl/fl}*, in which *Ezh2* is knocked out in odontoblasts; *K14-Cre;Ezh2^{fl/fl}*, in which *Ezh2* is knocked out in epithelial cells; and *Gli1-CreER;Ezh2^{fl/fl}*, in which *Ezh2* is lost in root progenitor cells; *Osr2KI-Cre;Ezh2^{fl/fl};Arid1a^{fl/+}*, in which haploinsufficiency of *Arid1a* is generated in *Osr2KI-Cre;Ezh2^{fl/fl}* mice. MicroCT scanning and histological analysis were combined to analyze the phenotypes of these mice. **Results:** When *Ezh2* expression was lost in the tooth mesenchyme in *Osr2KI-Cre;Ezh2^{fl/fl}* mice, only one root formed and the root furcation was defective. In contrast, inactivation of *Ezh2* in epithelial

cells lead to delayed furcation development. Loss of *Ezh2* in odontoblasts and root progenitor cells resulted in normal furcation and molar development. Importantly, *Arid1a* haploinsufficiency rescues root patterning defect in *Osr2KI-Cre;Ezh2^{fl/fl}* mice, indicating that *Arid1a* and *Ezh2* may work antagonistically to control the tooth furcation development. **Conclusions:** Our study provides evidence that Ezh2 in the tooth mesenchyme work antagonistically with *Arid1a* to determines the root number in mouse molars.

Poster #52

Title: Cardiomyocyte-specific deletion of PRMT1 dramatically improves heart function after myocardial infarction (MI)

Authors: Jian Wu, Olan Jackson-Weaver, Julia Qian, Rahul Gupta, Sok Ung, Henry M. Su-cov, & Jian Xu

Faculty advisor: Jian Xu

Background: Every 39 seconds an American will suffer for a heart attack. Protein-arginine-methyltransferase-1 (PRMT1) is a primary asymmetric dimethyltransferase. It methylates histone H4R3 facilitating histone acetylation and chromatin accessibility. It also methylates multiple non-histone proteins (e.g., SMAD6). PRMT1 global knockout leads to embryonic lethal. Heart-specific role of PRMT1 was not studied. **Purpose:** To assess the PRMT1 functions in the heart under disease condition. **Results:** Cardiomyocyte-specific deletion of PRMT1 was achieved by crossing *Myh6^{mer}Cre^{mer}* to *PRMT1^{fl/fl}* mouse. Left-anterior-descending-coronary-artery (LAD) ligation was used for myocardial infarction (MI) induction. We found PRMT1 was highly expressed in the nucleus of cardiomyocytes and forms irregular structures in the cardiomyocytes at the infarction-border zone. Genetic deletion and pharmacological inhibition (by MS023) of PRMT1 both dramatically improves the function of hearts subjected to MI by 50% and

100% (EF%) respectively, and also significantly decreased the MI-induced dilation of the left ventricle by 30% (Vs) and 20% (Vd). **Conclusion:** Suppression of PRMT1 facilitates the mouse heart recovery from "heart attack" induced by LAD ligation. Utilizing proteomics method, we will pinpoint the key PRMT1 methylation targets who play essential roles in the MI-induced heart failure. Harnessing this novel cardiac protective mechanism will pave the road for the use of pharmaceutical inhibition of PRMT1 as a novel therapeutic treatment for heart attack.

Poster #53

Title: Ameloblastin binds to phospholipid bilayers via a helix-forming motif

Authors: Jingtan Su, Natalie C. Kegulian, Rucha Arun Bapat, & Janet Moradian-Oldak

Faculty advisor: Janet Moradian-Oldak

Background: Ameloblastin (Ambn), the most abundant non-amelogenin enamel protein, is intrinsically disordered and has the potential to interact with other enamel proteins and with cell membranes. The mechanisms by which Ambn aids in enamel development are poorly understood and have been suggested to include cell adhesion to the extracellular matrix. Integrin-, heparin-, and fibronectin-binding motifs are poorly conserved in Ambn, leading us to our hypothesis that it interacts directly with membranes. **Purpose:** To define Ambn-phospholipid membrane interactions in vitro, pinpointing the region of membrane interaction in Ambn and identifying changes in Ambn and in membrane structure during interaction. **Methods:** We used Ambn, a series of Trp/Phe variants, deletion mutants, and peptides derived from different regions of Ambn and applied multiple biophysical methods including fluorescence, circular dichroism (CD), and light scattering to measure their interactions with liposomes.

Results: We found that Ambn binds to liposomes through a highly conserved motif within the sequence encoded by exon 5. Ambn-derived peptides that encompassed the sequence from this region bound to liposomes; peptides derived from other regions did not. Sequence analysis of Ambn across different species showed exon 5 to contain a highly conserved motif with a propensity to form an amphipathic helix. Deletion of this sequence resulted in loss of liposome binding. **Conclusion:** Our in vitro data suggest that Ambn binds lipid membrane directly through a conserved helical motif in exon 5 and have implications for biological events such as Ambn-cell interactions and Ambn signaling and secretion.

Poster #54

Title: PRMT1 and PARP1 crosstalk in the regulation of p53 function during epithelial-mesenchymal-transition and invasion

Authors: Balazs Murnyak & Jian Xu

Faculty advisor: Jian Xu

Background: Epithelial-mesenchymal-transition (EMT) is a key biological process during normal development, but it also occurs in pathological contexts, including tumor progression, and metastasis. Evidence suggests that p53 post-translational modifications play an important role in the regulation of EMT and invasion. Our lab previously revealed that protein arginine methyltransferase 1 (PRMT1)-p53 signaling controls EMT in cultured cells. Besides arginine methylation, p53 is also a target of poly(ADP-ribose)ylation by PARP-1 (poly ADP-ribose polymerase 1). PARP1 is often upregulated in various cancers and regulates EMT. **Purpose:** We aim to study the crosstalk between PRMT1 and PARP1 and assess how arginine methylation and poly(ADP-ribosyl)ation cross-regulate p53 function in EMT. **Methods:** To confirm whether PARP1 interacts with

PRMT1 and p53 during TGF- β -induced EMT, we employ the combination of in vitro binding assays and recombinant proteins and cell-based analysis. **Results:** p53 interaction with PARP1 and p53 PARylation were detected after TGF- β treatment in both A549 and 293T cells. On the other hand, PRMT1 depletion caused a decrease of PARP1 expression in A549 cells. PARP1 knockdown resulted in a significant nuclear-to-cytoplasmic shift of p53. Moreover, p53 cytoplasmic translocation was more intensive after TGF- β treatment. Based on our preliminary **Results**, we hypothesize that p53 is cross-regulated by PARP1 and PRMT1 in EMT. Our work presents new insights into novel biological pathways that may control EMT and cell invasion.

Poster #55

Title: Regenerating sutures in craniosynostosis

Authors: Mengfei Yu, Yuan Yuan, & Yang Chai

Faculty advisor: Yang Chai

Background: Craniosynostosis results in cranial deformities and other symptoms, which pose extensive and recurrent surgical management problems. For the past decade, tissue regeneration field has been greatly improved since the thriving of material science and stem cell biology. **Purpose:** In our study, we want to regenerate the coronal suture in *Twist*^{-/-} mice using complex hydrogels with normal suture mesenchymal cells. **Methods:** Photo-cross-linkable gelatin methacrylate (GelMA) modified with matrigel/collagen I (MC-GM) were used as scaffolds. *Twist*^{-/-} mice used in surgery were divided into five groups which treated with 1) blank control, 2) MC-GM control, 3) MC-GM + heat inactivated normal suture cells, 4) MC-GM + normal suture cells, 5) MC-GM + normal suture cells. Samples are collected at different time points. **Results:** 2 months after we surgically removed the fused coronal suture structure

of *Twist*^{-/-} mice, radiographic results showed that there were still some gaps between frontal and parietal bones in MC-GM + normal suture cells group, however the gaps became narrower in group MC-GM + heat inactivated normal suture cells and MC-GM control, and the two bones were almost fused in group MC + normal suture cells and blank control. After 3 months, the gaps still retained in MC-GM + normal suture cells group, while the gaps disappeared in all the other groups. Histomorphometric and immunofluorescence analysis also revealed the presence of Gli1+ cells between the bones only in MC-GM + normal suture cells group 3 months after surgery, which implied the suture-like structure formed. **Conclusion:** Thus, the complex hydrogels with normal suture cells may enhance suture regeneration and have a profound impact on regenerative medicine.

Poster #56

Title: NAMPT antagonizes tegument protein incorporation to restrict herpesvirus lytic replication

Authors: Na Xie, Shu Zhang, Mao Tian, Jun Xiao, Junjie Zhang, Jessica Carriere, Jun Zhao, Hao Feng, Richard Longnecker, Canhua Huang, & Pinghui Feng

Faculty advisor: Pinghui Feng

Metabolic pathways fuel the synthesis of macromolecules that underpin the proliferation of cells and propagation of pathogens. Metabolic enzymes are generally believed to be proviral. NAD is a key cofactor for enzymes catalyzing metabolic reactions. We report that the rate-limiting enzyme of the salvage pathway of NAD synthesis, NAMPT, restricts herpesvirus replication in an enzyme-independent manner. We demonstrated that NAMPT was packaged into the virion and reduced lytic replication of human herpes simplex virus 1 (HSV-1). Mechanistically, NAMPT targets two core tegument proteins, UL36 and

UL37 that mesh a scaffold for viral tegumentation during lytic replication. As such, NAMPT competitively antagonizes the incorporation of diverse tegument proteins into the virion, impairing viral tegumentation and infectivity. Finally, NAMPT demonstrated antiviral activity against multiple herpesviruses and loss of NAMPT rendered mouse highly susceptible to herpes simplex virus infection. This study uncovers a direct antiviral activity of a metabolic enzyme independent of its biosynthetic enzymatic activity and an unprecedented host defense mechanism targeting herpesvirus tegumentation.

Poster #57

Title: C9orf72 or Smcr8 deficiency disrupts lysosomal secretion and degradation leading to mTORC1 hyperactivation

Authors: Qiang Shao, Mei Yang, Chen Liang, Li Ma, & Jian-Fu Chen

Faculty advisor: Jian-Fu Chen

Purpose and Background: Hexanucleotide repeat expansion in C9orf72 intron causes the most common familial amyotrophic lateral sclerosis and frontotemporal dementia (collectively, C9ALS/FTD). Despite of its reduced expression in patients, C9orf72 function remains to be established. **Methods:** Cryosectioning, Confocal image and western blot are used to examine macrophage phenotype. **Results:** We report that impaired lysosomal degradation and the resulting mTORC1 hyperactivation are responsible for immune dysfunction in C9orf72 mutant mice. Our previous work revealed that C9orf72 forms a protein complex with Smcr8 (Science Advances, 2016). Here we found that C9orf72/Smcr8 double knockout (KO) mice exhibited similar but more severe immune defects than the individual KO, including macrophage dysfunction, splenomegaly and lymphadenopathy. In C9orf72 or Smcr8 mutant macrophages, lysosomal degradation, autophagosome clearance, and lysosomal se-

cretion were impaired due to the disruption of autolysosome acidification. As a result of impaired lysosomal degradation, mTOR protein was aberrantly increased, resulting in mTORC1 signaling overactivation. Pharmacological inhibition of hyperactive mTORC1 rescued macrophage dysfunction, splenomegaly and lymphadenopathy in C9orf72 mutant mice. **Conclusion:** Thus, Lysosomal secretion and degradation are disrupted in C9orf72/Smcr8 mutant macrophages leading to mTORC1 hyperactivation, inhibition of which arrests immune dysfunction in mutant mice, providing the first link between C9orf72's cellular function and its *in vivo* phenotype.

Poster #58

Title: Crucial role of Runx2 in root development

Authors: Quan Wen, Jifan Feng, Yuan Yuan, Shuo Chen, Thach-Vu Ho, Jingyuan Li, & Yang Chai

Faculty advisor: Yang Chai

Background: Runx2 is a well-known master transcription factor of osteogenic differentiation. There are also evidence for the involvement of Runx2 in tooth development, including odontogenesis and amelogenesis. However, the function of Runx2 during root formation remains to be clarified. Previously, our group found that Gli1+ cells are mouse molar root progenitor cells. **Methods:** Taking advantage of this Gli1-driven Cre-mediated recombination system, we generated *Gli1-Cre^{ERT2}; Runx2^{fl/fl}* mice in order to specifically knock out Runx2 expression in these root progenitor cells, and investigated the function of Runx2 during root formation. **Results:** Runx2 is highly expressed in the dental papilla and dental follicle during the molar crown-to-root transition period. After tamoxifen induction at PN3.5, the conditional knock-out (cKO) mice showed significant growth retardation and root defects. The roots of cKO mice are much shorter than the control, with

thinner dentin and impaired odontoblast differentiation, confirmed by Dspp staining. Also, the development of periodontal tissue, including the periodontal ligament, alveolar bone and cementum is arrested in cKO mice. Interestingly, we found that cell proliferative activities of cKO mice are increased in the apical region of dental mesenchyme. **Conclusion:** Taken together, our data indicates Runx2 is indispensable for mouse molar root development, possibly through a cell fate change of Gli1+ root progenitor cells from terminal differentiation to active proliferation.

Poster #59

Title: Insights from Bent Bone Dysplasia Syndrome: the mouse conditional *Fgfr2^{M391R}* knock-in allele disrupts fibrous joint development, yields pan suture fusions and craniofacial hypoplasia

Authors: Diana Rigueur & Amy Merrill

Faculty advisor: Amy Merrill

Background: Fibroblast Growth Factor Receptor 2 (*Fgfr2*) regulates osteoprogenitor proliferation, self-renewal and differentiation during skeletogenesis, yet it remains unclear how the receptor distinctly elicits these cellular processes. We discovered a nuclear feature of FGF signaling that will elucidate with specificity how *Fgfr2* regulates skeletogenesis from our analysis of Bent Bone Dysplasia Syndrome (BBDS), an FGFR2-disorder where osteoprogenitor cell fate decisions are biased towards self-renewal. **Methods & Results:** We developed a mouse conditional knock-in of the *Fgfr2^{M391R}* mutation that causes BBDS in humans. DNA sequencing of cultured primary osteoprogenitors treated with Adeno-GFP/Cre, confirmed efficient allele recombination. Immunofluorescence experiments further showed that the allele functions like that of BBDS, aberrantly translocating *Fgfr2* to the nucleus. Via MicroCT,

whole-mount skeletal preparations, and histological analysis, generation of a *Wnt1-Cre; Fgfr2^{M391R/tx}* and *Wnt1-Cre; Fgfr2^{M391R/tx}* in mouse renders facial hypoplasia, craniosynostosis and synchondrosis joint fusions, strongly suggesting that the mutation is dominant in mouse as in humans. Furthermore, *Wnt1-Cre; Fgfr2^{M391R/tx}* yields a pan suture fusion phenotype, strongly suggesting that dural *Fgfr2* plays an uncovered role in suture formation. **Conclusion:** Nuclear *Fgfr2* plays an imperative role in synchondrosis and suture development by exerting its effects from the osteogenic fronts and dura. Overall, insights from the BBDS mouse can be used to elucidate the endogenous and pathogenic roles of nuclear FGFR2 during craniofacial skeletal development.

Poster #60

Title: FGF signaling patterns cell fate at the interface between tendon and bone

Authors: Ryan R. Roberts, Lauren Bobzin, Creighton T. Tuzon, & Amy Merrill

Faculty advisor: Amy Merrill

Tendon and bone are joined through a transitional connective tissue known as the enthesis. The enthesis is morphologically graded from tendinous to osseous and arises from bipotent progenitors that co-express Scleraxis (Scx) and Sox9 (Scx+/Sox9+). While it is known that Scx+/Sox9+ progenitors have the potential to differentiate into either tenocytes or chondrocytes, the developmental mechanism that spatially resolves their bipotency has remained unknown. Here we demonstrate that FGF signaling spatially regulates differentiation of Scx+/Sox9+ progenitor cells in developing entheses of the mammalian lower jaw. We find that conditional loss of *Fgfr2* in neural crest-derived Scx+/Sox9+ progenitors disrupts their regional differentiation into tenocytes and chondrocytes, which subsequently disrupts the zonal architecture of the enthesis. We

show that these changes in the gradient of Scx+/Sox9+ progenitor differentiation are tightly correlated with altered expression of Notch pathway members. Correspondingly, neural crest-specific loss of Notch2 disrupt development of the mandibular entheses. Together these results suggest that Fgfr2 establishes a gradient of tenocyte and chondrocyte cell fate during entheses morphogenesis via Notch signaling.

Poster #61

Title: The critical role of Runx2 in homeostasis of the mouse incisor

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), since it grows continuously throughout the life of the animal. Previously, we found that quiescent Gli1+ cells near the neurovascular bundle are typical MSCs. Runx2 is a runt domain transcription factor that is essential for tooth development. 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 fate of MSCs. **Methods:** We generated *Gli1-Cre^{ERT2};Runx2^{fl/fl}* mice, in which Runx2 is lost in the Gli1+ lineage. The mice were euthanized 4 weeks after induction. The mandibles were collected and fixed. MicroCT, Hematoxylin and Eosin (H&E) staining, and immunofluorescence staining were carried out for analysis. **Results:** Elongated enamel and increased thickness of dentin were observed in mutant mice compared with wild type mice. A decreased number of proliferating cells in the preodontoblast and preameloblast regions were detected in the mutant mice. There were no apparent changes in apoptosis detected by TUNEL assay. The expression of dentin sialophosphoprotein (Dspp)

as well as amelogenin were shifted to an earlier stage. **Conclusion:** Runx2 plays an important role in regulating tissue homeostasis to balance proliferation as well as differentiation. Further studies are needed to investigate the molecular and cellular mechanism.

Poster #62

Title: A randomized controlled trial evaluating the efficacy of grafting the facial gap at immediately placed implants in the anterior maxilla: 3D analysis of bone and soft tissue changes

Authors: Diana Sedler & Homa H. Zadeh

Faculty advisor: Homa H. Zadeh

Background: The therapeutic benefit of biomaterial added in the horizontal gap between the implant and alveolar bone during immediate implant placement remains controversial. The aim of this randomized controlled clinical trial was to evaluate whether placement of anorganic bovine bone minerals in the facial gap at immediately placed implants is correlated with peri-implant bone and mucosal changes. **Methods:** Patients with a non-restorable maxillary anterior tooth were enrolled in this study. Following tooth extraction, implants with sloped platform and crestal microthreads (Astra Tech Profile) were placed into extraction sockets of maxillary anterior teeth and premolars, without flap elevation. Participants were randomly assigned to either experimental group (ABBM; Bio-Oss large particle size cancellous; Geistlich, Wolhusen, Switzerland) placed within the horizontal facial gap or control group (no graft). PVS impressions and CBCTs were obtained at pre-operative baseline and one year after implant placement. Study models were optically scanned and exported as STL files. The DICOM and STL files were imported into a 3D image analysis software (AMIRA) and superimposed for volumetric analysis. Linear and volumetric measurements were performed to evaluate several aspects of the buccal contours

and implant position. **Results:** The analysis of a representative sample is shown in Figure 1, illustrating superimposition of surface optical scans and CBCT images of pre- and post-operative scans, which allows for quantitative measurements in Table 1. **Conclusion:** Superimposition of surface optical scans over CBCT imaging is a novel technique and is feasible to make linear and 3D quantitative measurements of peri-implant bone and soft tissues.



Poster #63

Title: Investigation of the role of PRMT4 in bone development

Authors: Abhijit Babaji Shinde, Diana Rigueur, Amy Merrill, Baruch Frenkel, & Jian Xu

Faculty advisors: Jian Xu & Baruch Frenkel

Purpose: To investigate the role of protein arginine methyltransferase 4 (PRMT4) in bone development. **Background:** PRMT4 is a member of PRMT family of enzymes which catalyzes the methylation of arginine residues of both histone and non-histone proteins. PRMT4 is specifically known for potentiating transcription by methylating and recruiting transcription factors as well as for its role in pre-mRNA splicing. Previous reports suggest a role of PRMT4 in a vast majority of functions such as gene co-activation, cell differentiation, and embryogenesis. However, its functional significance in bone development and homeostasis remains obscure. In this project we study the role of PRMT4 in bone development using both in vitro and in vivo approaches. **Methods:** We employed immunohistochemical staining and qRT-PCR to evaluate PRMT4 expression during osteogenesis as well as effect of siRNA mediated PRMT4 depletion on osteogenesis in two osteoblast

precursor cell lines. We also generated *Prx1Cre-Prmt4^{-/-}* mice (Cre specific for early limb bud mesenchyme and a subset of craniofacial mesenchyme) and assessed their phenotype. **Results:** PRMT4 expression and nuclear localization increased in both osteoblast precursor cell lines after inducing osteogenesis. PRMT4 depletion reduced osteogenic differentiation as measured by mRNA levels of osteogenic markers. Whole mount skeletal staining of *Prx1Cre-Prmt4^{-/-}* mice showed delayed ossification of the sternum at E16.5, which eventually caught up by E18.5. **Conclusion:** These results suggest roles of PRMT4 in the process of osteogenic differentiation in vitro and embryonic bone development in vivo. Investigation with alternative Cre lines and further cellular and molecular investigation are underway.

Poster #64

Title: Real time monitoring of the formation and removal of biofilms from clinical-related pathogens using an impedance-based technology

Authors: Parish Sedghizadeh & Esmat Sodagar

Faculty advisor: Parish Sedghizadeh

Purpose: The aim of this work was to test the antimicrobial efficacy of novel bisphosphonate-antibiotic conjugates against clinically relevant bacterial bone biofilm pathogens using a rapid impedance-based real time cell analyzer. **Background:** Biofilms are described as surface-associated bacteria surrounded by a self-produced extracellular matrix. Many chronic infections, particularly bone infections, are caused by pathogenic bacteria growing as biofilms. Several methods are available to study such biofilms in vitro. However, these methods are limited by high labor intensity, intrusive sampling and/or long time lags from sampling. Therefore, sensitive, accurate, reproducible and faster methods are desirable for real time monitoring

of biofilms. **Methods:** By using impedance measurements in microtitre plates with gold electrodes we assessed in real time the antimicrobial effects of bisphosphonate-antibiotic conjugates against bacterial biofilms. For experimental purposes, the following microbial strains were used: *S. aureus* ATCC 6538, *P. gingivalis* ATCC 33277 and *Aggregatibacter actinomycetemcomitans* (Aa) D7S1. Moxifloxacin and ciprofloxacin were tested as the parent or control antibiotics and the following experimental bisphosphonate-antibiotic conjugates were synthesized and tested: etidronate-carbamate-ciprofloxacin and etidronate-carbamate-moxifloxacin. **Results:** The MIC results using a 16-well plate real time cell analyzer show that these new conjugates have high antibiotic efficacy in comparison to the non-conjugated antibiotics in osteomyelitis preventative and eradication experiments in vitro. **Conclusion:** Real time biofilm analysis provides a promising tool to evaluate antibiotic therapy in clinical or clinically relevant biofilm-mediated infections. Furthermore, this class of chemical conjugates, incorporating osteoadsorbent bisphosphonates with high bone affinity, and fluoroquinolone antibiotics for bone-targeted delivery to treat osteomyelitis biofilm pathogens

Poster #65

Title: Distinct expression patterns of *Aggregatibacter actinomycetemcomitans* core and accessory gene pools

Authors: Natalia Tjokro

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 often organized into genomic islands. The

functions of accessory genes remain to be elucidated. We hypothesized that accessory genes/genomic islands provide critical functions to Aa to survive in specific growth conditions. **Purpose:** To investigate the expression of Aa accessory genes/genomic islands and core genes in different growth conditions. **Methods:** Aa strain D7S-1 was grown in 4 different conditions: as planktonic cells or biofilms in enriched media, and as biofilms in two nutrient-poor media RPMI and Keratinocyte medium. The levels of transcripts were determined by RNA sequencing. **Results:** The median expression value for accessory genes/genomic islands was ~2 fold lower than core genes. Accessory genes/genomic islands were activated to a greater extent than core genes in nutrient-poor media. We also noted elevated expressions of certain core genes in nutrient-poor media, such as genes involved in the biosynthesis of lipopolysaccharides and cytolethal distending toxins. **Conclusion:** Aa accessory gene pool and core gene pool exhibit distinct expression profiles. Activation of accessory genes/genomic islands 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 #66

Title: Runx2 regulates oropharyngeal muscle development through tissue-tissue interaction

Authors: Summer Xia Han, Jifan Feng, Eva Janečková, Thach-Vu Ho, Jingyuan Li, Junjun Jing, Brian Song, & Yang Chai

Faculty advisor: Yang Chai

Purpose: To investigate the regulatory mechanisms of oropharyngeal muscle development. **Background:** Oropharyngeal structures are involved in daily physiological functions such as speaking, swallow-

ing, breathing and hearing. Previous studies have shown that signaling molecules from cranial neural crest cells are important for craniofacial muscles development. RUNX2 deficient human patients have craniofacial muscle defects. We hypothesize that Runx2 is likely to regulate oropharyngeal muscle development through tissue-tissue interaction. **Methods:** We performed immunofluorescent staining and in situ hybridization to analyze the expression patterns of Runx2 relative to myogenic cells at different stages during soft palate development. We generated *Osr2-Klcre;Runx2^{fl/m}* mice to knock out *Runx2* in a subset of cranial neural crest-derived cells. To analyse the phenotype, we have performed microCT and histology analysis of the mutant mice. We also performed RNA-seq analysis to identify the possible regulating mechanisms of Runx2 for soft palate muscle formation. **Results:** We have shown that Runx2-positive cranial neural crest-derived cells are closely associated with a subset of myogenic progenitors during soft palate development. *Osr2-Klcre;Runx2^{fl/m}* mice have cleft and muscle defects in the posterior part of their soft palates at newborn stage. Based on the RNA-seq data analysis, we have identified several downstream targets of Runx2 for regulating soft palate muscle formation. **Conclusion:** This study will contribute to our understanding of how cranial neural crest cells guide muscle development in the oropharyngeal region. This work may lead to the development of better strategies for oropharyngeal muscle regeneration.

Poster #67

Title: Single-cell transcriptome analysis of differentially staged BM-MSCs reveals a cancer progression pathway evolved in multiple cancer types

Authors: Xuelian Chen, Andres Stucky, Shengwen Calvin Li, Xi Zhang, & Jiang F. Zhong

Faculty advisor: Jiang F. Zhong

The detrimental effects of mesenchymal stem cells (MSCs) in some reports eclipse their benefits in clinical application, despite their wide support and adoption in bone marrow transplantation. The heterogeneity of MSC populations may be responsible for variation in the efficacy of MSC-based therapy. Here we report on single-cell transcriptome analysis of individual MSCs at various stages of differentiation and gene expression profile clustering in three discrete stages of osteogenesis, which led to the discovery of YAP1 overexpression associated with undifferentiable MSCs. Further large-scale surveys of cancer genome sequencing data available from the NIH Genomic Data Commons and Oncomine database revealed a correlation between YAP1 overexpression and cancer progression. A YAP1-specific pathway was inferred using a large-scale meta-analysis of 51 clinical databases across 6965 patients, confirming that YAP1-interacting networks could contribute to the prognostic power and potentially serve as a therapeutic target for cancer patients. This study draws on the evolved mechanism of YAP1 overexpression in MSCs to shed fresh light on cancer progression.

Our single-cell study found that increases in YAP1 levels associated with differentiation-resistant MSCs may impact the efficacy of MSC treatment and affect MSC-evolved cancer progression. Understanding of this mechanism could contribute predictive power to the diagnosis of patients. Known or novel biologically active molecules targeting YAP1-Hippo pathway may improve treatment for a defined subset of patients.

Poster #68

Title: Function of epithelium-derived Shh signaling during root formation

Authors: Yuanyuan Ma, Jingyuan Li, Jifan Feng, Junjun Jing, Yuan Yuan, Xia Han, Thach-Vu Ho, Congchong Shi, Eva Janečková, Jinzhi He, Tin-

gwei Guo, Mengfei Yu, Shuo Chen, Quan Wen, Jiahui Du, Bridget Samuels, & Yang Chai

Faculty advisor: Yang Chai

Background: Mammalian tooth root development begins after the completion of crown formation and is regulated through epithelial-mesenchymal interactions. BMP-mediated Sonic hedgehog (Shh) signaling in the dental epithelium controls dental epithelial stem cell fate to regulate root formation. Furthermore, Shh signaling regulates root formation in a dose-dependent manner. **Purpose:** The aim of this project is to investigate how epithelium-derived Shh signaling precisely controls root formation through the regulation of dental epithelial stem cell fate *in vivo*. **Methods:** We generated mice with epithelial-specific loss- or gain-of-function of Shh signaling: *K14-rtTA;Teto-cre;Smo^{fl}* and *K14-rtTA;Teto-cre;R26SmoM2^{fl/+}*, respectively. Doxycycline rodent diet was administered every day from E16.5. **Results:** Epithelial-specific deletion of Shh and Smo at E16.5 has no effects on root formation. However, constitutive activation of Shh signaling in the dental epithelium **Results** in shortened roots with abnormal Hertwig's epithelial root sheath (HERS) formation at P14.5. At PN8.5, compared to the bi-layered structure in controls, HERS in *K14-rtTA;Teto-cre;R26SmoM2^{fl/+}* mice has an expanded multi-layer, "swollen" morphology, with ectopic Amelx expression. **Conclusion:** These data indicate that sustained Smo activation in epithelium inhibits postnatal root development.

Poster #69

Title: Identifying lineage specification domains within the mandibular arch using single-cell RNA sequencing

Authors: Yuan Yuan, Xia Han, Jifan Feng, & Yang Chai

Faculty advisor: Yang Chai

Purpose: To understand how the patterning process shaping

out and guiding the formation of different tissue type within the mandible. Specifically, to understand the heterogeneity of the early mandibular arch and the specification process of different cell lineages. **Background:** The development of mandible is a complex process involving progenitor cell specification to multiple lineages that will form different types of tissues in a spatial and temporal manner. I'm particularly interested in the cellular and molecular components in the early mandible development. During the early developmental stage, patterning domains are established without the obvious expression of these marker genes. **Methods:** I utilized single cell RNA sequencing technique combining with *in vivo* lineage tracing study to look into the cellular and molecular heterogeneity of mandibular arch at different stages, trying to fill the gap between the early patterning process and later tissue formation. **Results:** We first identified patterning domains in E10.5 mandibular arch based on anatomical locations. Unsupervised clustering of E12.5 mandible reveals different cell lineages derived from either cranial neural crest cells (CNCCs) or mesoderm. Moreover, we identified several functional domains within E10.5 mandibular arch involving myogenic, odontogenic, chondrogenic and osteogenic lineage differentiation. **Conclusion:** Using single cell RNA sequencing analysis, we have a deeper understanding of the CNCCs specification and mandibular arch patterning process in terms of its function in guiding the differentiation.

Poster #70

Title: Modeling microcephaly with cerebral organoids and mice reveals a WDR62-CEP170-KIF2A pathway promoting cilium disassembly in neural progenitor cells

Authors: Wei Zhang, Si-Lu Yang, Stephanie Herrlinger, Mei Yang, Qiang Shao, John L. Collar, Edgar Fierro, Yanhong Shi, Aimin Liu, Hui Lu, Bruce E. Herring, & Jian-Fu Chen

Faculty advisor: Jian-Fu Chen

Background and Purpose: Primary microcephaly is caused by neural progenitor cell (NPC) depletion due to mutations in genes encoding for centrosomal proteins including *WDR62* and *KIF2A*. However, cellular and molecular mechanisms underlying microcephaly, particularly in human NPCs, remain elusive. **Methods:** By creating *Wdr62* mutant mice and human cerebral organoids. **Results:** *WDR62* deletion resulted in smaller sizes of organoids and mouse brains due to the disruption of NPCs, including outer radial glia (oRG), a subtype of NPCs that are barely detected in rodents but critical for human neocortex growth. *WDR62* ablation led to retarded cilium disassembly, unusually long cilia, and delayed cell cycle progression leading to decreased proliferation and premature differentiation of NPCs. Mechanistically, WDR62 interacts with and promotes CEP170's localization to the basal body of primary cilia, where CEP170 recruits microtubule-depolymerizing factor KIF2A to disassemble cilia. WDR62 depletion reduced KIF2A's basal body localization, and enhanced KIF2A expression rescued deficits in cilium length, proliferation, and differentiation of mutant NPCs. **Conclusion:** Modeling microcephaly in cerebral organoids and mice reveal a WDR62-CEP170-KIF2A pathway promoting cilium disassembly, disruption of which contributes to NPC depletion and microcephaly.

UNDERGRADUATE AND DDS BASIC SCIENCES

Poster #71

Title: Microvasculature defects recapitulated in tooth pulp of rate AD model

Authors: Simon Youn, Casey Griffin, Ariana Rodriguez, Edmond Onwukwe, Brian Leung,

Terrence Town, & Ruchi Bajpai

Faculty advisor: Ruchi Bajpai

Purpose: To test whether human tooth pulp can serve as a diagnostic tool to identify patients predisposed to getting Alzheimer's disease. **Background:** Alzheimer's disease (AD) is a progressive neurodegenerative disease that is most often characterized by the accumulation of amyloid plaques and neurofibrillary tangles. There is no cure, but there are treatments that can slow the progression. However, there is no early diagnostic tool available to start treatments as early as needed. Furthermore, amyloid plaques and neurofibrillary tangles are late signs of Alzheimer's disease. In recent research, pericyte defects have become an important focus of AD. Pericytes of the blood-brain-barrier are neural crest derived cells that wrap around the endothelial cells of blood vessels and are critical for stabilization of blood vessels. However, a brain biopsy would not be ideal for patients to look for pericyte defects. Interestingly, neural crest cell derived pericytes also infiltrate craniofacial tissue including the tooth pulp. **Methods:** Analysis of rat brain at different ages from wild-type and AD model rats. Analysis of rodent tooth pulp from wild-type and AD model rats. Analysis of patient teeth at different ages and disease statuses. **Results:** Microvasculature defects in brains of AD rats predicted from our stem cell studies and consistent with microvasculature defects in patient brain samples. Microvascular defects and reduced pericyte coverage in isolated root pulp and oral cavity from the same animal models. **Conclusion:** Tooth pulp of AD rat serves as a powerful tool to identify pericyte defects that predispose patients to Alzheimer's disease.



Poster #72

Title: Characterization of expression profiles in soft palatal muscle development

Authors: Josefine Ekholm, Aileen Ghobadi, Eva Janečková, & Yang Chai

Faculty advisor: Yang Chai

Background: The posterior region of the secondary palate, known as the soft palate, is composed of four muscles in mice. The soft palate is crucial to several functions such as swallowing, breathing, and talking. Consequently, if muscle fibers are not properly oriented and the soft palate has a cleft, these functions are disrupted. Although surgical procedures exist, complete restoration is yet to be accomplished. The comprehensive network of signaling pathways pertinent to the basic muscle development of soft palatal muscles remains undiscovered. **Purpose:** Expression patterns of Wnt, Shh, and Fgf signaling were investigated to advance the knowledge of molecular pathways involved in the embryonic development of soft palatal muscles. **Methods:** Histological analysis of *Axin2-LacZ* and *Gli-LacZ* reporter mice was used in addition to RNAscope (Axin2, Gli1, Etv4/5, Fgf receptors) and immunohistochemistry on C57BL/6J mice. **Results:** Our results showed abundant expression of Wnt, Shh, and Fgf signaling pathways in early embryonic development of soft palatal muscles. RNAscope co-localization with myosin heavy chain revealed expression of these signaling pathways predominantly in cranial neural crest-derived mesenchymal cells surrounding the muscle fibers and also in myogenic cells themselves. While Fgf signaling was consistently expressed throughout soft palate development, at later stages, Wnt and Shh signaling pathways were diminished from CNC-derived mesenchymal cells and Shh signaling from myogenic cells as well. **Conclusion:** The current study suggests that Wnt, Shh, and Fgf signaling pathways are dynamically expressed during soft palate development, indicating a potential signaling network playing a role in development of soft palatal muscles.

indicating a potential signaling network playing a role in development of soft palatal muscles.

Poster #73

Title: High throughput functional analysis of *Aggregatibacter actinomycetemcomitans* genes via transposon sequencing

Authors: Christie Shen & Natalia Tjokro

Faculty advisor: Casey Chen

Background: Gram-negative facultative *Aggregatibacter actinomycetemcomitans* (Aa) is a putative keystone periodontal pathogen that exhibits complex relationships with the host and other niche-sharing microbial species. Less than 5% of the ~2,000 protein coding genes in the Aa genome have been fully characterized. These unknowns present a major challenge to study the pathogenesis of Aa. Toward that goal, transposon sequencing (Tn-seq) may reveal essential genes for Aa infections. **Purpose:** To identify essential genes of Aa in infections via Tn-seq. **Methods:** Tn libraries were established for Aa strains D7S-1 and HK1651 by published **Methods**. The random single-insertion of the transposon was verified by sequencing. The libraries were tested in a polymicrobial setting of Aa and another partner species. The input and output mutants were analyzed by sequencing and compared to identify essential genes in the conditions. **Results:** Transposon libraries have been developed for Aa strains D7S-1 and HK1651, and these mutants should contain transposon insertions in all non-essential genes. The libraries are then screened in a polymicrobial biofilm. Comparison of input and output mutants identify putative essential genes for Aa to persist in the polymicrobial biofilms. The relative importance of each gene for growth in a polymicrobial environment will be determined by comparing the abundance of the mutant before and after growth. **Conclusion:** Tn-seq is a versatile tool to identify functional Aa genes under different

conditions, including conditions that mimic in vivo Aa infections.

Poster #74

Title: 3D reconstruction of muscle defects in mouse cleft soft palate

Authors: Sara Kahng, Brian Song, Thach-Vu Ho, Xia Han, Jifan Feng, & Yang Chai

Faculty advisor: Yang Chai

Background: The soft palate is the posterior part of the secondary palate and is involved in important daily physiological functions such as speaking, swallowing, breathing, and hearing. Soft palate malformation or clefting, is a common congenital craniofacial defect in humans. Patients with soft palate malformations often have disorganized palatal muscles with reduced numbers of myofibers, which severely impair the normal functions of the soft palate. **Purpose:** 3D reconstruction of all the muscles of the soft palate provides improved spatial visualization of the muscle deformity and can help develop better clinical treatments of patients with soft palate malformation. **Methods:** *Osr2-Kl-cre;Runx2^{fl/m}* mutant mice show reduced muscle volume in the soft palate at newborn stage (unpublished data). Histological analysis of soft palate muscles of both control and mutant mice was performed by paraffin sectioning and MHC immunofluorescence staining. Images were taken from each section of the soft palate and imported into BioVis software for 3D reconstruction. **Results:** The levator veli palatini and palatopharyngeus muscle volumes are reduced in the mutants compared to control mice. In addition, the levator veli palatini reveals a cleft deformity compared to the continuous sling formation in the control mice. **Conclusion:** 3D reconstruction of soft palate muscles allows for better understanding of the anatomical defects in the mutant mice, which recapitulate those seen in humans, and can be utilized as a model to develop treatment strategies in the future.

UNDERGRADUATE AND DDS CLINICAL SCIENCES

Poster #75

Title: Emergency management of traumatic dental injuries among school nurses in Long Beach Unified School District, CA

Authors: Daniel Adelpour, Chieh Tsai, Chantelle Aabedi, & Marissa Carvalho

Faculty advisor: Julie Jenks

Purpose: The purpose of this study is to assess the knowledge and ability of school nurses in the Long Beach Unified School District to manage and properly treat traumatic dental injuries (TDI), specifically tooth avulsion, in school children, immediately after a lecture in handling TDI. **Background:** Dental trauma is one of the important problems to be addressed in schools. Falls, fights, and sport injuries are among the common causes of dental trauma in schools. The result from previously administered questionnaire to school nurses in the school district of Long Beach strongly suggests that there is a need for training in the management of TDI, specifically avulsion amongst the participants. **Methods:** A lecture on the management of TDI in primary and permanent teeth was given to the participants by a pediatric dentist. A post training questionnaire was administered to the same population immediately after training session. The questionnaire contains objective questions to measure the changes in participants' knowledge in the management of TDI after the training. The surveys contain no questions leading to any identifiable data on an individual level. **Results:** The results from the immediate post-training survey demonstrated significant improvement ($P < 0.05$) in knowledge of TDI management

among participants compared to the pre-training survey results in October 2018. **Conclusion:** First part of study suggested need for CE courses for school nurses to familiarize/train them to handle TDI properly. After TDI training, the participants demonstrated significant improvement in their knowledge.

Poster #76

Title: Emergency management of traumatic dental injuries among school nurses and health clerks in Pasadena Unified School District, CA

Authors: Marissa Carvalho, Daniel Adelpour, Chantelle Aabedi, & Chieh Tsai

Faculty advisor: Julie Jenks

Purpose: The purpose of this study is to assess the knowledge and ability of school nurses and health clerks in the Pasadena Unified School District to manage traumatic dental injuries (TDI) specifically tooth avulsion, in school children, immediately after, 4 months after, and 1 year after a lecture in handling TDI. **Background:** Dental trauma is one of the important problems to be addressed in schools. Falls, fights, and sport injuries are among the common causes of dental trauma in schools. The result from previously administered questionnaire to health clerks and school nurses in the school district of Pasadena suggests that there is a need for routine follow-up training in the management of TDI. **Methods:** A lecture on the management of TDI in primary and permanent teeth was given to the participants by a pediatric dentist. A post training questionnaire was administered to the same population both immediately, and 4 months after training session. A refresher lecture was given 1 year following the initial questionnaire, and a post-training questionnaire was administered immediately after the refresher lecture. The questionnaire contains objective questions to measure the changes in participants' knowledge in the management of TDI

after the training. **Results:** Results from the 1-year time point demonstrated improvement in knowledge of TDI management among health clerks compared to the 4-month follow-up results in March 2018. **Conclusion:** After TDI training, the participants demonstrated significant improvement in their knowledge. The 4-month follow-up results showed a decrease in TDI knowledge that was recovered with the refresher lecture.

Poster #77

Title: Ethical numbness: an investigation of educational models of dental local anesthesia instruction

Authors: Kristeen Chu & Eumi Choi

Faculty advisor: James Tom

Background: Traditionally, in dental education, the established method of teaching local anesthesia administration to pre-doctoral dental students has involved student-to-student injections. However, administering anesthesia involves risks and potential for tissue damage. Complications such as hematoma, trismus, and paresthesia can be caused by any intraoral injection technique. The once common practice of peer-to-peer injections is now being challenged in light of ethics. Administering intraoral injections for no therapeutic purpose and without a process of informed consent specifically violates the notions of autonomy and nonmaleficence. The need for a process of informed consent and a choice to receive injections or students currently enrolled in a dental program is the focus of a revised curriculum of dental local anesthesia education. **Purpose:** The purpose of this study is to collect preliminary data for a longitudinal, retrospective study. The long-term goal is to evaluate the need for any paradigm shifts in the dental community to implement a consistent process of informed consent starting in the pre-doctoral level and to emphasize and stimulate a thorough discussion of risks versus benefit. **Methods:** Two

surveys were developed: one for faculty and one for students. Surveys consisted of a series of ordinal questions and participants were asked to rate on a scale of one to five ranging from whether they strongly disagreed or strongly agreed with a certain belief. These surveys were distributed to the clinical faculty dentists and Class of 2020 dental students at the Herman Ostrow School of Dentistry. **Results:** Currently in process. **Conclusion:** Not yet completed.

Poster #78

Title: A retrospective study on the retention of sealing primary 2nd molars

Authors: Richard Kim, Marissa Carvalho, & Elena Bigun

Faculty advisor: Gardner Beale

Background: Terra Bella is annual Ayuda free pediatric clinic destination focused on providing comprehensive dental care to a patient population that due to financial constraints and lack of access to care is underserved. In such a population, sealing primary molars may prove valuable. **Purpose:** To determine the retention rate of sealants placed on second primary molars and whether it would be beneficial to seal these molars in this population. **Methods:** Patients were selected for the study through a treatment planning process where all virgin primary and secondary molars were selected to

be sealed. Each student was instructed to place a sealant as follows: Scrub tooth with toothbrush for 15 seconds, Etch enamel with 35% phosphoric acid for 30 seconds, Rinse tooth with water for 15 seconds, Resin Sealant was placed, Light cure tooth for 30 seconds. Sealants were checked by Pediatric Faculty. All participants were given OHI and a cleaning. No further home instructions were provided. **Results:** Participants for the sealants (N=17) were identified from the total number of students participating in the volunteer dental clinic (N = 120). Of the total number of sealants placed (N=128), 48 of these were sealants were placed on primary second molars. **Conclusion:** The success of sealants was measured by retention of the sealant. Namely, if the sealants remained sealed in returning patients of the Terra Bella clinic in March 2018. Success in retention was based on sealants of 2nd primary molars and of the 48 2nd primary molar sealants placed, 38 remained.

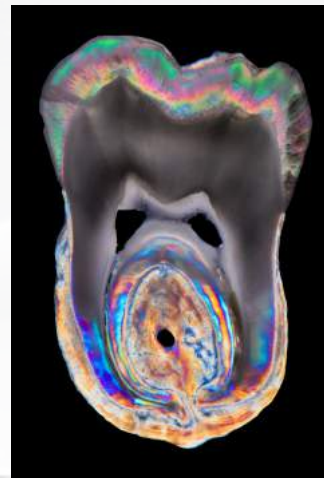
Poster #79

Title: 10-Year retrospective analysis of risk factors associated with MRONJ

Authors: Pardis Barati Mahvar, Amna Imran, Reyes Enciso, Andrew Sanapanya, Mohammad Khalifeh, Parish Sedghizadeh, & Laurel Henderson

Faculty advisor: Parish Sedghizadeh

Background: The association between antiresorptive therapies (ART), like bisphosphonates and denosumab, and osteonecrosis of the jaw has been well documented in the literature. Risk factors studied include type of ART, duration of treatment, and other factors, but are limited by methodological challenges, including sample size. **Purpose:** This institutional study at the University of Southern California (USC) Herman Ostrow School of Dentistry explores the association between ART, duration of treatment, cancer, and type of cancer, with medication-re-



lated osteonecrosis of the jaw (MRONJ) in the robust USC patient population. Dentists frequently treat patients who have ART and improved risk analyses may aid in preventing morbidity in the dental setting. **Methods:** Our electronic health records between 2007 and 2017 were queried with Oracle database management software by an Information Technology Data Analyst for inclusion in this study. Inclusion criteria comprised patients of any sex, age, ethnicity, department of care, or duration of treatment with a history of ART. Exclusion criteria comprised any patients who did not take ART, who had osteoradionecrosis, or who were involved in a University MRONJ study. Statistical analyses were performed using SPSS. **Results:** Statistically significant associations were identified between type of ART taken and MRONJ (Chi-square: $p < .001$), cancer and MRONJ (Chi-square: $p < .001$), type of cancer and MRONJ (Chi-square: $p < .001$), and duration of treatment with ART and MRONJ (independent t-test: $p < .001$). **Conclusions:** USC MRONJ patients have taken mostly alendronate for osteoporosis treatment, have cancer, and have a history of taking ART for (\pm SD) 5.64 ± 4.94 years.

Poster #80

Title: 3D printing of custom nasal stents for babies with cleft lip and palate

Authors: Lauren Yen, Yasumura Toshihiko, Jeff Hammoudeh, Lori Howell, William Magee, Mark Urata, & Stephen Yen

Faculty advisor: Stephen Yen

Background: After primary repair of the lip and nose in infants with cleft lip and palate, nasal stents are used to support the nose after the repair. Currently, generic nasal stents are being used in the United States. **Purpose:** This pilot project will test whether we can design a custom nasal stent to improve nasal symmetry and 3D print it out of FDA approved materials. **Methods:** A model of a nasal

stent was carved out in dental stone and scanned with the 3Shape dental scanner. Orthoanalyzer software was used to smooth out surface irregularities and add an extra bump layer to overcorrect the nasal projection and compensate for post-treatment shrinkage. The file was converted to STL format and modified with Fusion 360 software to add a connector and nasal holes to the virtual stent. The custom nasal stent was printed on a Moonray printer using NextDent Ortho IBT resin (Sprintray, Los Angeles, CA). **Results:** The printed stent is soft and flexible, has a connector to prevent accidental inhalation of the stent, and has the additional bump of material to support the nose. to ensure that the breathing hole The nasal hole is wide enough to insert a suction bulb. **Conclusion:** It is possible to 3D print custom nasal stents. Our next step is to scan the nose and create a mirror of the image of the good side without a cleft deformity to provide a model for creating the nasal stent

Poster #81

Title: Evaluate the antimicrobial activity of *Satureja khuzistanica* against *Enterococcus faecalis* in human root canals and compared its antimicrobial effectiveness with sodium hypochlorite 2.5% and chlorhexidine gluconate 2%

Authors: Shiva Mishaeel & Reihane Zare

Faculty advisor: Afshin Azimi

Purpose: The purpose of this in vitro study was to evaluate the antimicrobial activity of *Satureja khuzistanica* against *Enterococcus faecalis* in human root canals and compared its antimicrobial effectiveness with, sodium hypochlorite 2.5% and chlorhexidine gluconate 2%. **Methods:** Fifty extracted, single-root, mature, human premolar teeth with single canal were prepared to standardize specimens. the smear layer, was removed and the samples translate in to brain heart infusion broth and were autoclaved then, samples were

inoculated with *Enterococcus faecalis* and were incubated in microaerophilic condition for 48 hours. The teeth were randomly allocated to 5 groups: 1) sodium hypochlorite 2.5%, 2) chlorhexidine gluconate 2%, 3) *Satureja khuzistanica* 0.31 mg/ml, 4) *Satureja khuzistanica* 0.62 mg/ml, 5) positive control. Dentin chips collected with H-type files into trypticase soy agar plates and incubated in 35°C/5% CO₂ for 48 hours. Colony forming units (CFU) was counted. **Results:** in 1, 2, 3, 4 groups, total CFU was minimum and there were significantly different, between positive control and other groups. Disinfection activity of experimental groups: Group 1: 99.93, Group 2: 99.49, Group 3 and 4: 99.97. **Conclusion:** *Satureja khuzistanica* 0.31 mg/ml appears to be an intracanal irrigant instead of sodium hypochlorite and chlorhexidine gluconate.

Poster #82

Title: Advanced platelet-rich fibrin for soft tissue augmentation

Authors: Nathan A. Nouria, Micah Tabanfar, Neema Bakhshalian, & Alexandre-Amir Aalam

Faculty advisor: Neema Bakhshalian

Background: Connective tissue graft is the gold standard for soft tissue augmentation and root coverage procedures. However, morbidity of the donor area is a concern. Therefore, several other materials have been used for soft tissue augmentation. Advanced platelet-rich fibrin (A-PRF) is a type of platelet concentrate which can be used as an autogenous graft material for this procedure. **Purpose:** The aim of this retrospective study was to evaluate the efficacy of A-PRF in root coverage procedure using a 2D image analysis protocol. **Methods:** Twelve patients who underwent full-mouth gingival augmentation procedure using A-PRF were included in the study. The digital intra-oral photographs from pre- and 24 months post-therapy were

superimposed in Adobe Photoshop. The areas of denuded root surfaces were measured in each picture and compared between the 2 time-points. To assess the percentage of root coverage, a non-parametric longitudinal model was run. **Results:** The model found a highly significant difference ($p < .0001$) between the denuded root surface pre- and post-operative. The pre values were found to be significantly higher (median of 10056.00 pixels) as compared to post (median of 1295.00 pixels). **Conclusion:** The present study revealed that A-PRF can effectively decrease the denuded root surface when used in gingival augmentation procedures. Hence, it can be an ideal alternative to connective tissue graft. Additionally, with this new technique patients experienced decreased pain, swelling and recovery time. Longer term follow-ups and controlled clinical trials are necessary to compare A-PRF and connective tissue graft efficacy.

Poster #83

Title: Can the direct approach be as promising as indirect when restoring large MOD defects?

Authors: Mehrdad Razaghy, Luciana Mara Soares, & Pascal Magne

Faculty advisor: Pascal Magne

Background: Restoring large MOD defects can be challenging due to polymerization shrinkage stresses. **Purpose:** To compare mechanical performance and enamel-crack propensity of direct, semi-direct, and CAD/CAM approaches for large MOD composite resin restorations. **Methods:** 45 extracted maxillary molars underwent standardized slot-type preparation (5-mm depth and bucco-palatal width) including immediate dentin sealing (Optibond FL) for the inlays (30 teeth). Short-fiber reinforced composite resin (EverX Posterior covered by Gradia Direct Posterior) was used for the direct approach, Gradia Direct

Posterior for the semi-direct, and Cerasmart composite resin blocks for CAD/CAM inlays. All inlays were adhesively luted with light-curing composite resin (preheated Gradia Direct Posterior). Shrinkage-induced enamel cracks were tracked by transillumination photography. Cyclic axial isometric chewing (5-Hz) was simulated, starting with a load of 200N (5,000 cycles), followed by stages of 400, 600, 800, 1000, 1200, and 1,400N (maximum 30,000 cycles each) until fracture or to a maximum of 185,000 cycles. Survived specimens were subjected to fatigue-to-failure test at 30-degree angle on the palatal cusp. **Results.** Shrinkage-induced cracking rates were 47%, 7%, and 13% for direct, semi-direct, and CAD/CAM inlays, respectively. Survival to accelerated fatigue was similar for all three groups (Kaplan Meier $P>.05$), ranged between 87% (direct) to 93% (semi-direct, CAD/CAM). Similarly, fatigue-to-failure test values did not differ significantly (Life Table analysis, $p>.05$) at 1,775N, 1,900N, and 1,675N, respectively. **Conclusions.** All three restorative techniques yielded excellent mechanical performance above physiological masticatory loads. Direct restorations performed as good as inlays when a short-fiber reinforced composite resin base was used.

Poster #84

Title: A novel, orally-controlled device to assist a paraplegic pianist to use piano foot pedals

Authors: Axel Ochoa, Carlos Sanchez, Jonathan Mendoza, Curtis Young, Sam Landsberger, Stephen Yen, & John Wieland

Faculty advisors: Samuel Landsberger & Stephen Yen

Background: After meeting a talented young pianist who lost motor control of his lower legs, a group of engineering students based at California State University Los Angeles, a professor of engineering, a master machinist and a CHLA orthodontist set out to give

him control of the piano pedal through an oral pressure sensing device. Prior to this invention, other groups unsuccessfully tried to produce a device for this pianist who has won competitions in Baroque music, but could not venture into later Classical and Romantic music requiring the sostenuto piano pedal. **Purpose:** to build a device that can control the piano pedal with tongue pressure. **Methods:** Kinematic innovation and electro-mechanical design, including focus upon intra-oral sensor sensitivity and water-proofing. **Results:** In August 2018, a device was made that could adapt quickly to any piano, apply pressure to the foot pedal and be controlled by tongue pressure. Different pressure-sensing switches were tested, and a hard acrylic shell and soft mouthguard material overlay was used to embed and insulate the wires and sensors from saliva. The device was connected to an Arduino computer controlling a motor that rotates a metal wheel to engage and disengage the piano pedal. **Conclusions:** Extensive testing at home and school has proven the design sturdy enough to withstand daily piano practice and performance. For the first time, the patient is able to transport the device, rapidly deploy it and play Beethoven with the use of the foot pedal.

OTHER AFFILIATED DENTISTRY / CCMB RESEARCHERS

Poster #85

Title: Molecular signaling regulating mesenchymal stem cell niche in mouse incisor

Authors: Arman Ohanyan, Eva Janečková, & Yang Chai

Faculty advisor: Yang Chai

Background: Mice incisors are truly unique in terms of their growth and development, as

they continually grow throughout the entire lifespan of these rodents through activity of epithelial and mesenchymal stem cells (MSCs) located at the proximal end of incisor. This continuous replacement of cells makes the mouse incisor a perfect model for studying this complex mechanism. Along with the importance of MSCs in regeneration and tissue homeostasis, it is also crucial to understand the microenvironments where these cells reside. The progeny of MSCs are transit amplifying cells (TACs). The rate of MSC to TAC transition and subsequent rate of TAC proliferation and differentiation into odontoblasts or dental pulp cells maintains the incisor homeostasis. **Purpose:** The main purpose of this study is to explore the largely unknown signaling network that guides the fate of MSCs as well as their niche. **Methods:** RNA-seq, immunofluorescence, histology of *Gli-CreER;Tgfb2^{fl}* and *Gli-CreER;Smo^{fl}* conditional knockout mice and *Gli1-LacZ* reporter mice. **Results:** *Gli-CreER;Tgfb2^{fl}* mice display impaired odontogenesis 2 months after tamoxifen injection whereas their dentinogenesis and amelogenesis are increased. The proliferation activity in the area of cervical loop where TACs are located is decreased, both in the mesenchyme and epithelium, resulting in premature differentiation of odontoblasts and ameloblasts. *Gli-CreER;Smo^{fl}* mice showed similar but more severe phenotypes. **Conclusion:** Our preliminary data indicate the importance of Tgf- β and Shh signaling in regulating stem cell niche homeostasis and consequently odontogenesis. Further experiments are necessary to elucidate their exact role in this process and regulation of MSC fate.

Poster #86

Title: An experimental animal model for head and neck lymphedema

Authors: Giulia Daneshgaran, Connie B. Paik, Michael N. Cooper, Wan Jiao, Sun Young Park, Tea Jashashvili, Iveta

Vorobyova, Yang Chai, & Alex K. Wong

Faculty advisor: Alex K. Wong

Background: Head and neck lymphedema (HNL) is a disfiguring complication of head and neck cancer treatment. Animal models of lymphedema are used to test pharmacologic and microsurgical therapies, which can offer improved results compared to standard conservative therapies. However, no animal model for HNL has been described in the literature to date. **Purpose:** The purpose of this study is to describe the first reproducible rat model for HNL. **Methods:** Animals were split into 2 groups: 1) 18 experimental rats received combined lymphatic injury via cervical lymph node resection and radiation therapy, 2) 18 control rats received sham surgery. Outcomes included biweekly measurements of neck circumference, maximum face width, and head and neck fat content on MRI. Lymphatic drainage was measured at day 60 via indocyanine green (ICG) lymphography, after which animals were sacrificed for histological and molecular analysis. **Results:** Postsurgical lymphedema was observed 94% of the time in the experimental group (17/18). Compared to controls, experimental animals experienced significant growth in neck circumference (12% change, $P<0.0001$), maximum face width (10% change, $P=0.0003$), and fat volume (18% change, $P=0.04$). Experimental animals had significantly slower lymphatic drainage as measured by ICG clearance ($P<0.05$), and 83% greater subcutis thickness on histology ($P=0.0083$), indicating subcutaneous tissue expansion. Finally, experimental animals had 66% greater relative expression of transcription growth factor- $\beta 1$ (TGF- $\beta 1$) mRNA, indicating increased fibrosis. **Conclusion:** We demonstrate that combined lymphatic injury in rats leads to a reproducible model of head and neck lymphedema, as evidenced by significant changes in clinical, histological, and molecular outcomes.



Poster #87

Title: Regulatory mechanisms of soft palate development and malformations

Authors: Jingyuan Li, Gabriela Rodriguez, Xia Han, Eva Janečková, Sara Kahng, Brian Song, & Yang Chai

Faculty advisor: Yang Chai

Cleft palate is a common congenital birth defect that significantly compromises the quality of affected babies' lives. Causes of cleft palate are numerous, including multiple genetic and environmental factors. Our study looked at regulation of soft palate development, which remains largely unknown. Cleft of the soft palate leads to misorientation of several muscles, causing oropharyngeal deficiency and adversely affecting speech, swallowing, breathing, and hearing. Importantly, we show that anatomy, function, and development of soft palatal muscles are similar between humans and mice, rendering the mouse an excellent model for investigating molecular and cellular mechanisms of soft palate clefts. Cranial neural crest-derived cells (CNCCs) provide important regulatory cues to guide myogenic progenitors to differentiate into muscles in the soft palate. Signals from the palatal epithelium also play key roles via tissue-tissue interactions mediated by TGF- β , Wnt, Fgf, and Hh signaling molecules and their inhibitors. Additionally, transcriptional regulators such as Dlx5 have been associated with a subset of muscles in the soft palate, suggesting how these known regulatory networks may achieve functional specificity in regulating muscle formation. Finally, we highlight some of the animal models that correlate with specific subtypes of soft palate clefts in humans and provide perspective on

how to use animal models to gain a better understanding of soft palate clefting. Given the advancements in biology and biomedical engineering, we are confident that combining our new knowledge of regulatory mechanisms of soft palate development with tissue engineering will achieve improved treatment outcomes for patients with soft palate clefts.

Poster #88

Title: Deficiency identification and impact on performance measures in learner-centered education

Authors: Jennifer Jordan & Mahvash Navazesh

Faculty advisor: Mahvash Navazesh

Purpose: This study aims to reveal student deficiency trends in the biomedical, behavioral or pre-clinical components of a Learner-Centered (LC) program, using admissions parameters, including ethnicity, gender, age, educational background, pre-dental GPA or performance on standardized exams, and their relationship to achievement of on-time graduation (OTG), 1st attempt pass on National Board Dental Exams Part 1 (NB1) or Part 2 (NB2), and WREB. **Background:** Responding to changes in technology, student need, national and state board examination, and evolving accreditation standards, the pre-doctoral dental program has progressed from a Problem-Based Learning (PBL) pedagogy, to an integrated LC model, utilizing PBL group learning and pre-clinical module experiences in D1 and D2. Allowing for curricular changes 2005-2010, the pre-doctoral dental classes of 2015 to 2018 share the most comparable curriculum models for assessment. **Methods:** Data includes admission demographics, scores for D1 and D2 DPBL Structure, Function and Behavior (SFB), and pre-clinical modules (PCM). Population includes pre-doctoral dental classes 2015 – 2018 (N=578), and assesses a sub-group of students with deficiencies (N=62), in trimesters 1 - 6. This

subgroup represents 10.7% of the population. **Results:** SFB and PCM deficiencies showed a declining trend, with rates decreasing from 21% to 5% of the class population. Declining trends are also present, in this sub-group, with 1st attempt fail rates NB1 decreasing from 7% to 0%; NB2 decreasing from 9% to 0%; and WREB decreasing from 3% to 0%. Late grads also present a declining trend, decreasing from 10% of the eligible class population to 1%. D1 and D2 deficiencies are not a barrier to performance on NB1, NB2, WREB or OTG. **Conclusions:** With the early identification of deficiencies, and intervention, our learner-centered pedagogy does not limit performance on external measures (NB1, NB2, WREB) or cumulative experiences leading to OTG.

Poster #89

Title: Role of Twist1 and Tcf12 in postnatal cranial suture patency maintenance

Authors: Karen Agustin-Rodriguez, Jinzhi He, & Yang Chai

Faculty advisor: Yang Chai

Background: Cranial sutures play an important role in the development of the skull. Cranial sutures act as articulations that hold the cranial bone together, absorb mechanical force, which protects the osteogenic tissues and the underlying bone, and it's the site where cranial bone growth occurs. In order for the cranial suture to function, it must stay unfused and stay in the patent state until the sutures close. In 1997, two groups detected the function mutations in *TWIST1* gene from Saethre-Chotzen syndrome patients, which concludes that suture fusion is a process of ossification. From the given information, Twist1 might impose a negative impact on the process of bone formation. Recently, our laboratory found that Gli1+ cells are mesenchymal stem cells in adult mice cranial suture and are mostly in the mid-suture region and most importantly, Twist1 impacts the Gli1+ stem cells. Our group hy-

pothesized that Tcf12-Twist1-hedgehog axis is important to maintain adult cranial suture patency postnatally through mediating Gli1+ mesenchymal stem cells. **Results:** We confirmed that Gli1+ cells reside in the middle region of adult mice using Td-Tomato reporter mice and tested to see if Tcf12 is expressed in adult mice cranial suture. Then to test the role of Tcf12 and Twist1, we generate Tcf12 and Twist1 with Gli1-Cre, used double flox and knockout mutant mice, and induced the mice with tamoxifen. Our overall results conclude that after a number of weeks, the coronal suture narrowed and there was no obvious suture fusion within the span of four to fourteen weeks.

Poster #90

Title: Modeling the development of the mouse mandible

Authors: Jerry Ruvalcaba, Yuan Yuan, Zoe Johnson, & Yang Chai

Faculty advisor: Yang Chai

Background: With the plethora of craniofacial diseases that are present all over the world, it is crucial to be able to trace the development of these illnesses. To be able to do this, a roadmap of normal development is necessary. The development of mandible is a complex process involving progenitor cell specification to multiple lineages that will form different types of tissues in a spatial and temporal manner. With this, we sought to create a map of features, which take shape through the different developmental stages of the mice mandible. **Methods:** Through immunostaining, RNA scope, and micro CT scans, we were able to collect images of the different stages of mice mandible development, and from this drew the differences over time. **Results:** At stage E12.5, we were able to detect structures such as tooth bud, dental mesenchyme and Meckel's cartilage through histology analysis, and through staining of the osteogenic markers such as Runx2, we found out that the mandible bone primordium forms at the same stage. Also,

with MicroCT imaging analysis, calcified bone structure started to form at E15, and grew into shape gradually.

Poster #91

Title: Epithelium-derived Fgf signaling controls tooth root formation via epithelial-mesenchymal interaction

Authors: Jingyuan Li, Quan Wen, Tingwei Guo, Thach-Vu Ho, Jifan Feng, Yuan Yuan, & Yang Chai

Faculty advisor: Yang Chai

Background: The Fgf signaling pathway is involved in mediating epithelial-mesenchymal interactions that are crucial for organogenesis, such as tooth formation. During tooth development, dental epithelial cells known as the Hertwig's epithelial root sheath (HERS) play a critical role in root formation following crown development. Previous studies have shown that Fgf10 signaling in the dental mesenchyme is indispensable in controlling the crown-to-root transition via the regulation of HERS formation during molar development. However, the mechanism of how the epithelium-derived Fgf signaling controls tooth root formation is still largely unknown. **Methods:** To explore the role of Fgf signaling in the dental epithelium during tooth root formation, we used an rTA transactivator/tetracycline promoter approach that allows inducible attenuation of Fgf signaling. **Results:** Specific ablation of Fgfr2 in the dental epithelium affects root formation and results in short roots in adult K14-rTA;Teto-Cre;Fgfr2^{fl/fl} mice. Morphologically, loss of Fgfr2 in the dental epithelium causes abnormal HERS formation and leads to early disappearance of HERS during root development. Without Fgfr2 in the dental epithelium, cell proliferative activities are decreased in both HERS and dental mesenchyme of the apical region. At the molecular level, Wnt signaling activities are also reduced, in parallel with the decreased cell proliferation. **Conclusion:** Taken together, our data suggest that

Fgf signaling in the dental epithelium regulates tooth root development via epithelial-mesenchymal interaction, possibly through crosstalk with Wnt signaling pathway.

Poster #92

Title: Comparison between the pharyngeal airway space in patients with skeletal class I, II, and class III malocclusion using McNamara analysis

Authors: Melika Haghighi, Prya Dey, & Jeny Mary George

Faculty advisor: Jeny Mary George

Background: There is a significant correlation between obstruction of airways and craniofacial growth pattern. Orthognathic surgery has been regularly performed to treat dentofacial deformities which as well, has an effect on posterior airway space. Narrow airways can result in impaired respiration, airway obstruction, mouth breathing, sleep apnea, and permanent defect. The present study is designed and to compare airway space in different skeletal malocclusion to prove the importance of the importance of patient screening prior to orthognathic surgery. **Purpose:** The objective is to study the pharyngeal airways of subjects with skeletal class I, class II, class III malocclusion using McNamara's Analysis. The purpose of this study is to help verify the relationship between skeletal malocclusion and pharyngeal airway in order to help Oral and Maxillofacial surgeons and orthodontists in exploring treatment plan options. **Methods:** 100 lateral cephalograms from Ajman University used to study the skeletal malocclusion and pharyngeal airways in non-growing patients aged between 18-25 in both males and females. **Results and Conclusion:** The result showed that there is a statistically significant difference between the three skeletal malocclusions. Those with skeletal class II malocclusion have significantly decreased airway space.

Poster #93

Title: Understanding the role of DYRK1A and APP in human brain pericyte

Authors: Varsha Neelakantan, Casey Griffin, & Ruchi Bajpai

Faculty advisor: Ruchi Bajpai

Background: Cerebrovascular dysfunction and leaky blood-brain barrier have emerged as early indicators of Alzheimer's disease. Loss of/defective pericytes, which are critical components of the cerebrovascular unit, leads to the breakdown of the barrier. Animal studies have shown that defective pericytes accelerate AD like pathology in models of AD. Thus, genes affecting pericyte function or viability may contribute to AD progression in patients. Various studies including familial AD cases, analysis of patients with Down's syndrome or GWAS, have revealed a cohort of gene variants associated with Alzheimer's diseases. While many labs are studying the effects of these variants in AD affected cells like neurons, astrocytes and microglia, I was interested in understanding if AD genes have specific roles in pericyte biology and vascular health. **Methods:** I used shRNA to knockdown APP, DYRK1A, and APOE in primary human brain pericytes. **Results and Conclusion:** While this did not affect pericyte viability, proliferation, migration or expression of common pericyte specific proteins they resulted in a consistent and reproducible defect in pericyte-endothelial cells crosstalk. In particular, pericyte induced upregulation of gamma-catenin a junction protein required to maintain a stable barrier was compromised. This result is an indication that DYRK1A and APP may be involved in pericyte function and that pericyte specific defects are due to multiple genes which could serve as potential targets for treating AD.

Poster #94

Title: Anterior segmental distraction to correct CI III malocclusion and crowded maxillary dental dentition.

Authors: Vincent Lu, Mark Urata, Jeffrey Hammoudeh, Dennis-Duke Yamashita, & Stephen Yen

Faculty advisor: Stephen Yen

Background: Originally, we developed anterior maxillary distraction osteogenesis as a way to correct CI III malocclusions in patients who suffered trauma to the anterior teeth. **Purpose:** We adapted this strategy as a novel strategy to treat patients who have CI III malocclusion with resistant scar tissue and dental crowding. **Methods:** We present a series of three patients who used this novel strategy to correct the cleft-related CI III malocclusion. Rapid palatal expansion screws were rotated 90 degrees to make a device that could elongate in the anterior posterior deminsion. The anterior bands and a wire loop for TADs was placed mesial to the incision line; the posterior bands were on the maxillary first molars. A segmental osteotomy was made between the anterior and posterior bands. The direction of cuts was worked out with conebeam CT images of the inter-radicular spaces. After a three days period of consolidation, the anterior segment was distracted. **Results:** The CI III malocclusion was corrected by creating space in the distraction site that could be used to resolve dental crowding. **Conclusion:** This technique is an alternative to LeFort I maxillary osteotomy in patients who may have either relapsed from prior LeFort I surgery or in patients who are unwilling to go through an orthognathic surgery.

Poster #95

Title: Use of TADs and segmental osteotomies to reshape the maxillary arch in patients with difficult cleft lip and palate presentations.

Authors: Vincent Lu, Mark Urata, Jeffrey Hammoudeh, Dennis-Duke Yamashita, & Stephen Yen

Faculty advisor: Stephen Yen

Background: It is difficult to

align the maxillary segments when the alveolar cleft is more than the width of a tooth. In this poster, we present cases that combine segmental osteotomies with TADs to reshape the upper arch. **Purpose:** To demonstrate the novel use of dentoalveolar surgery and orthodontics to solve difficult clinical problems with cleft lip and palate. **Methods:** Large alveolar defects were corrected by placing TADs in segments, segmental alveolar osteotomies and constriction of the alveolar defect with orthodontic appliances in patients with cleft lip and palate ages 8-12 to move segments of maxillary bone containing teeth through the cleft defect and to create room for a crowded dentition. The segments of bone moved along orthodontic archwires. We present a series of three patients. **Results:** The unusually large cleft spaces were closed with segmental distraction, there was a successful grafting of the alveolar cleft, and the archform was normalized and coordinated with lower dental archform. **Conclusion:** Segmental osteotomies helped to treat cleft defects greater than a cm in width.

Poster #96

Title: Correcting nasal deformity for infant born with cleft lip and palate by modified nasal stent supported by beta titanium wire on Nasoalveolar Molding appliances

Authors: Xuanyu Lu & Stephen Yen

Faculty advisor: Stephen Yen

Background: Presurgical cleft lip and palate orthopedics is aim to reduce the severity of the initial cleft deformity. The Nasoalveolar Molding (NAM) technique utilizes wire and acrylic nasal stents attached to an intraoral denture, which is used to mold the nasal cartilages, premaxilla, and alveolar bridges into normal form and position during the neonatal periods. Commonly, the nasal stent is fashioned from 0.036-inch stainless steel wire attached on the intraoral appliance. **Purpose:** Assess

the treatment outcomes of the modified nasal stent on NAM appliance by beta titanium wire with decreased shaping force on soft tissue and nasal cartilage to correct the nasal deformity. **Methods:** A 3-week old bilateral cleft lip and palate neonatal male presented in the orthodontic clinic for presurgical orthopedic treatment. A silicone impression was taken for fabrication of molding plate. The nasal stents were made of 0.030-inch round beta titanium wire and shaped as swan neck. **Results:** In total, NAM treatment was ten visits based on the weekly adjustment. The columella was centered and elongated from 0.5mm to 5mm, Prolabium length increased from 5mm to 11mm, alveolar cleft size reduced from 11mm to 2mm. The symmetry of lower lateral alar cartilage and nasal tip projection were improved significantly. **Conclusion:** This modified nasal stent made by beta titanium wire provides lighter soft tissue molding force. This novel approach achieved maximum treatment outcomes.

Poster #97

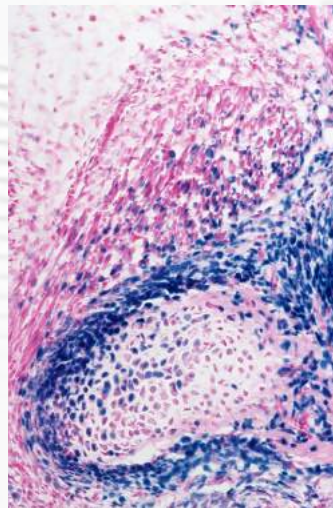
Title: MSC-mediated regeneration of swine calvarial critical-size defect using a 3D-printed scaffold

Authors: Zoe Johnson, Xiang-jia Li, Yuan Yuan, Yong Chen, & Yang Chai

Faculty advisor: Yang Chai

Background: Incidents of head trauma, congenital defects, disease, and tumor resection often leave patients with large, full-thickness calvarial defects that are incapable of healing on their own. These critical-sized defects (CSDs) are currently treated by surgeons using metal or plastic implants, which are inconvenient for the patient and inferior architecturally to natural bone. There is a significant need for improved treatment of critical-size calvarial defects. **Purpose:** In this study we used dental pulp neural crest mesenchymal stem cells (DPNCCs) to regenerate bone in a calvarial CSD, forgoing the use of metal or plastic implants and bone grafts. **Methods:** Autologous

DPNCCs were obtained from the swine incisor and expanded over 2 weeks. A 3cm defect was made in the calvaria, an injury so large that it will not naturally heal over the course of our study (12 weeks). The cultured DPNCCs were transplanted into the injury. To coerce DPNCCs to differentiate into functional osteoblasts upon transplantation, we combined them with nanoparticles of hydroxyapatite and tricalcium phosphate (HA/TCP). **Results:** Dense, cortical bone was regenerated with DPNCCs and the HA/TCP nanoparticles in vivo, but to improve the quality and structure of the regenerated bone, we are designing a 3D-printed osteoconductive scaffold made from HA/TCP and a biodegradable polymer. **Conclusion:** We have successfully regenerated cortical bone in the swine calvaria using dental pulp-derived mesenchymal stem cells and HA/TCP. This research advancement represents a unique opportunity to utilize MSC-mediated tissue regeneration in improving care for human patients with calvarial CSDs.



BIOKINESIOLOGY & PHYSICAL THERAPY FACULTY

Poster #98

Title: Psychometric Properties of the Chronic Headache Self-Efficacy Scale (CHASE)

Authors: Lisa Baek, Meghan Lamothe, Jenna Hankard, Erica Sigmund, Lori Ginoza, Lori A. Michener, & Federico Pozzi

Background: Chronic headaches affect approximately 4% of the population and have a

debilitating impact on activities of daily living (ADL's). Higher self-efficacy, or the belief in

one's ability to manage and control headaches, is correlated with lower depression, anxiety, and physical symptoms in patients with chronic headaches. CHASE is a 14-item patient report scale developed to identify and measure the self-efficacy related to elements of daily activities in patients with chronic headaches. **Purpose:** To evaluate the psychometric properties of CHASE. **Methods:** Participants (n=21) diagnosed by a neurologist with chronic headaches or migraine were included in the study. Participants completed the CHASE, Headache Management Self-Efficacy Scale (HMSE), Headache Impact Test-6 (HIT-6), Global Rating of Change (GROC), and Patient Acceptable Symptom State (PASS) at three time points: initial encounter, post-24 to 72 hours, and post-12 weeks. Statistical analyses were performed to determine validity, reliability, standard error of measurement, minimal detectable change, and responsiveness of the scale. **Results:** Preliminary results indicate excellent reliability and acceptable validity, error, and responsiveness when compared to other reliable and valid headache-based outcome measures (HIT6, HMSE). Participant recruitment continues in order to ful-

ly assess reliability, validity, measurement error, and responsiveness of the CHASE. **Conclusion:** This is an ongoing study with preliminary results that indicate excellent reliability, acceptable validity error, and moderate responsiveness when compared to other reliable and valid headache-based outcome measures. This scale may provide clinicians a means to assess self-efficacy and behaviors specific to the management of chronic headaches.

BIOKINESIOLOGY & PHYSICAL THERAPY PHD CANDIDATES

Poster #99

Title: Functional connectivity for a hand muscle compared to the trunk: same or different?

Authors: Alaa M. Albishi, Jason J. Kutch, & Beth E. Fisher

Faculty advisor: Beth E. Fisher

Background: We previously showed a distinct functional connectivity of external oblique (EO) represented in the primary motor area (M1) compared to the functional connectivity of EO represented in the supplementary motor area (SMA). We found that the representation of EO in M1 is more connected to areas responsible for volitional execution while EO representation in SMA is more connected to postural control areas. It is well established that EO can be recruited for movement execution or postural stabilization while a hand muscle such as first dorsal interosseous (FDI) is mainly recruited for volitional execution. Therefore, we hypothesized that M1 network for FDI compared to SMA network will be less distinct than M1/SMA networks for EO. **Purpose:** Determine the brain networks for M1 and SMA representations of FDI. **Methods:** Transcranial magnetic stimulation and task-based functional magnetic resonance imaging

(fMRI) were used to map FDI representations in M1 and SMA. The FDI representations were then used as seeds in a whole-brain functional connectivity analysis utilizing resting-state fMRI (rs-fMRI). The FDI connectivity map of M1 was compared to SMA. **Results:** Similar to the results for EO, FDI representation in SMA is more connected to basal ganglia and cerebellum while primary somatosensory and parietal cortex are more connected to M1. Slight differences in lateralization were observed in FDI compared to EO. **Conclusion:** Basic features of differential connectivity of SMA and M1 appeared to be muscle-independent. The lateralization of FDI in the left cerebellum may be due to single cortical innervation of FDI compared to EO.

Poster #100

Title: Trunk control in and out of an episode of recurrent low back pain

Authors: Hai-Jung Steffi Shih & Kornelia Kulig

Faculty advisor: Kornelia Kulig

Background: Low back pain (LBP) has become a global health issue due to its high recurrence rate and disabling nature. Research investigating whether altered trunk control persists beyond symptom duration is warranted, as it may contribute to future recurrence. **Purpose:** This study aims to investigate trunk kinematic coordination and muscle activity in and out of an episode of recurrent low back pain. **Methods:** Five individuals with recurrent LBP were tested both in and out of an episode. Eleven back-healthy controls were also tested. Testing consisted of walking on a treadmill with a 5 different prescribed step width using real-time visual feedback. Surface electromyography (EMG) of bilateral longissimus and kinematic data of the thorax and pelvis were captured at 1500 and 125 Hz, respectively. EMG data were normalized to peak gait activation and averaged through gait cycle. Trunk kine-

matic coordination was categorized into 4 patterns using the vector coding approach. **Results:** Individuals with recurrent LBP showed a decrease in muscle activation as well as trunk in-phase pattern when they are out of pain. However, they achieve this by means of increased pelvis-only pattern, as opposed to a higher anti-phase demonstrated by the back-healthy controls. Those with recurrent LBP also were less adaptive to varying step widths in their trunk control. **Conclusion:** In individuals with recurrent low back pain, symptom remission did not result in a return to a back-healthy state of trunk control.

Poster #101

Title: The learning process and neural substrates linked to a discovery task and a future for modulation

Authors: Andrew Hooyman, Jason J. Kutch, Nicolas Schweighofer, Beth E. Fisher, James Gordon, & Carolee J. Winstein

Faculty advisor: Carolee J. Winstein

Background: Discovery tasks are an under investigated area of motor learning which may be highly relevant to our overall understanding of how humans learn motor skills. **Purpose:** The purpose of our research into complex discovery tasks is three-fold: First, we aimed to better understand the learning processes associative with successful learning of a discovery task. **Results:** Our results indicate that optimal performance on the task requires initial high levels of exploration followed by adequate exploitation to acquire and then retain maximum success. Second, we wished to better understand where the processes of exploration, exploitation and retention of a discovery task exist within the human brain. Using resting-state Electroencephalography (rs-EEG) we performed a whole brain analysis of every feasible rs-EEG functional connectivity pair to predict exploration, exploitation and retention of the discovery task. We were able

to identify three distinct and predictive networks for each phase. Finally, to better understand the plasticity underlying the predictive functional connectivity of the discovery task, we developed a novel intracortical Paired Associative Stimulation (iPAS) paradigm aimed at increasing connectivity along a specific rs-EEG intracortical circuit. Results of our paradigm demonstrated feasibility that iPAS can significantly increase functional connectivity of a specific resting-state fronto-motor circuit compared to two separate controls. **Conclusion:** Overall, we were able to uncover the learning processes and neural substrates associated with a discovery task and develop a future neuromodulatory method that may better define the causal relationships between the brain and behavior in relation to the learning of a motor skill.

Poster #102

Title: Exploratory learning to encourage selective leg movement in infants born full-term and very preterm

Authors: Jeongah (Jane) Kim, Sungwoo Park, Linda Fetters, & Barbara Sargent

Faculty advisor: Barbara Sargent

Background: Infants born very preterm (VPT) are at increased risk for motor impairments. In previous research, infants born full-term (FT), but not VPT, generated more selective hip-knee movements when interacting with a kick-activated mobile. **Purpose:** Determine if infants born FT and VPT learn our scaffolded mobile task, and infants who learn the task exhibit increased selective hip-knee movements and increased exploratory foot movements. **Methods:** 12 infants born FT and 10 infants born VPT at 4 months corrected age participated in the scaffolded task. Day 1: a 2-min Baseline, spontaneous kicking, followed by an 8-min Mobile condition, during which the mobile activated when the infant lifted either foot vertically over an individualized threshold. Day

2-3: a 10-min Mobile condition, during which the threshold height was increased. Learning was quantified as mobile active time (MAT) ratio, the duration that infants activated the mobile. Selective movement was quantified as the hip and knee angle correlation coefficient (Hip-Knee CC). Exploration was quantified as the trajectory space of the foot markers. Mixed regression models using repeated measures were used to test differences of the variables between Baseline and the Last Day Mobile condition. **Results:** FT and VPT groups demonstrated learning (increased MAT ratio, $p < .01$). FT Learners ($n=9$) and VPT Learners ($n=7$) demonstrated more selective movements (decreased Hip-Knee CC, $p < .05$). FT and VPT Learners demonstrated increased exploration (increased space, $p < .01$). **Conclusion:** These findings are consistent with our hypotheses that infants born FT and VPT learn the task, and that Learners generate more selective movements and explorations.

Poster #103

Title: Pelvis width predicts frontal plane hip/knee kinematics during running

Authors: Jia Liu, Kristi L. Lewton, & Christopher M. Powers

Faculty advisor: Christopher M. Powers

Background: Excessive hip adduction and knee valgus during running have been reported to contribute to knee injuries. These movement impairments are thought to be the result of hip abductor weakness, but studies have shown that strength is a weak predictor. Another factor that is likely contributory is the pelvis morphology. Specifically, a wider pelvis may necessitate that the femur to adduct relative to pelvis to maintain the center of mass over the base of support during running. **Purpose:** To determine the associations among hip abductor strength, pelvis width and frontal plane hip and knee kinematics during running. **Methods:** 11 healthy recreational runners (18-45

years old) underwent biomechanical assessment of running (7 miles/hour), strength evaluation, and computed tomography. Peak hip adduction and peak knee valgus during the deceleration phase of running were calculated. Hip abductor strength was normalized to body mass. Pelvis width was determined as the distance between bilateral hip joint centers (Bi-HJC). Pearson correlations were used to determine the associations among kinematics, strength, and morphology variables. **Results:** Hip abductor strength was not significantly associated with either peak hip adduction ($r = -0.189$, $p = 0.577$) or peak knee valgus ($r = -0.336$, $p = 0.313$). In contrast, the Bi-HJC distance was significantly associated with both peak hip adduction ($r = 0.665$, $p = 0.026$) and peak knee valgus ($r = 0.618$, $p = 0.043$). **Conclusion:** The width of the lower pelvis, as opposed to hip abductor strength, was associated with frontal plane hip and knee kinematics. This suggests that muscle strengthening may have limited influence on correcting frontal plane excessive kinematics in runners.

Poster #104

Title: Are slip-induced compensatory responses coordinated by the vestibular system?

Authors: Jonathan Lee, Christopher Asplund, Sarah Ruegg, Lauren Vera, & Christopher M. Powers

Faculty advisor: Christopher M. Powers

Background: The vestibular system may be responsible for initiating corrective reactions to slips as the semicircular canals, and the utricle and saccule, are sensitive to angular and linear accelerations of the head, respectively. **Purpose:** To compare the timing of head acceleration to the onset of upper and lower extremity muscle responses during a slip. **Methods:** Ten healthy adults participated. EMG of the left deltoid and right tibialis anterior were obtained using surface electrodes. Kinematic data were obtained at 150 Hz.

Participants wore a full-body harness for safety and walked along a 10-meter walkway at 1.45 m/s. Mineral oil was placed on the force platform to induce an unexpected slip. Onset of EMG activity was determined when the slip trial EMG activity levels exceeded baseline trial activity by 1 SD for at least 50 ms. Onset of head acceleration was derived from the forehead marker and was determined by when the head acceleration exceeded baseline trial activity by 2 SDA. **Results:** No significant differences were found in onset timing of the left deltoid (63.8 ± 9.6 ms) and right tibialis anterior (61.6 ± 8.1 ms). Neuromuscular onsets were significantly earlier than the onset of head acceleration (239 ± 66.7 ms). **Conclusions:** Corrective neuromuscular responses of the upper and lower extremities preceded the onset of head acceleration. It is unlikely that the vestibular system is responsible for initiating corrective responses during a slip.

Poster #105

Title: Effect of exercise on endothelial function during breast cancer chemotherapy

Authors: Kyuwan Lee, Irene Kang, Joanne E. Mortimer, & Christina M. Dieli-Conwright

Faculty advisor: Christina M. Dieli-Conwright

Purpose: We sought to determine the effects of an 8-week HIIT intervention on vascular endothelial function in breast cancer patients undergoing anthracycline chemotherapy. **Background:** Anthracycline chemotherapy is a cardio-toxic regimen by nature and may contribute to cardiovascular disease mortality by reducing vascular endothelial function in breast cancer patients. High intensity interval training (HIIT) has been shown to increase endothelial function compared to moderate intensity exercise in patients with obesity. **Methods:** Thirty

breast cancer patients were randomized to either HIIT or control (CON) groups. The HIIT group participated in an 8-week HIIT intervention occurring 3 times per week on a cycle ergometer. The CON group was offered the HIIT intervention after 8 weeks. At baseline and week 9, endothelial function was assessed using FMD. FMD was measured from the brachial artery diameter at baseline and 1min after cuff deflation. Repeated measures ANOVA was performed to assess changes in endothelial function. **Results:** At baseline, the HIIT group ($n=15$) and CON group ($n=15$) groups did not differ by age (46.9 ± 9.8 years), BMI (31.0 ± 7.5 kg/m²), and systolic/diastolic blood pressure ($116.1 \pm 11.8/72.3 \pm 5.6$ mmHg). Post-exercise, FMD significantly increased from baseline in the HIIT group (wk 0: $12.6 \pm 6.8\%$, wk 9: $16.9 \pm 8.1\%$; 19.8%) when compared to baseline and the CON group ($P < 0.05$). FMD significantly decreased from baseline (wk 0: $13.0 \pm 4.3\%$, wk 9: $6.1 \pm 2.8\%$; -21.9%) in the CON group ($P < 0.05$). **Conclusion:** HIIT improved endothelial function in breast cancer patients undergoing. Larger randomized trials are needed to establish the optimal exercise strategy to attenuate chemotherapy-induced cardio-toxicities on endothelial function.

Poster #106

Title: Can golf influence gait speed and cognition in older adults?

Authors: Nicole Marcione, Andrea Du Bois, Steven Castle, & George Salem

Faculty advisor: George Salem

Background: Gait speed and cognition are important predictors of successful aging. Both slow gait speeds and cognitive decline are associated with poor health outcomes, including hospitalization, falls, institutionalization and death. Exercise interventions can improve both gait and cognitive performance in older adults. Golf is a multi-modal, cognitively-challenging

physical activity. **Purpose:** The purpose of the present study was to examine the influence of a 12-week golf intervention on walking performance and cognition in older adults. **Methods:** Gait speed and cognition were measured in intervention (INT) and control (CON) groups (n=20) before and after a 12-week period. The INT participated in a 12-week golf training program (2 x weekly; 90 min per session). All participants completed six-minute walk test (6MWT), fast single-task gait speed (STGS), fast dual-task gait speed (DTGS) with a subtraction by 3s task, California Verbal Learning Test (CVLT) and National Institute Health Toolbox-Cognition (NIH-C). **Results:** 2x2 (Time*Group) Mixed ANOVA revealed significant time*group interactions for 6MWT (p=0.05), STGS (p=0.02), DTGS (p=0.01), CVLT (p=0.01), and NIH-C Fluid Cognition (p=0.06) had a trend towards significance. Post-hoc t-tests demonstrated that INT significantly improved their pre-to-post 6MWT, STGS, DTGS, CVLT, and NIH-C Fluid. CON had no significant pre-to-post intervention changes. **Conclusion:** Participants in the 12-week golf training program improved gait and cognitive performance, compared to CON. These results provide evidence that golf, as a cognitively-challenging physical activity, may improve physical and cognitive function, leading to attenuated risk for poor health outcomes, maintaining independence and improved quality of life.

Poster #107

Title: Effects of visual feedback manipulation of precision and psychological states

Authors: Akira Nagamori, Christopher M. Laine, & Francisco J. Valero-Cuevas

Faculty advisor: Francisco J. Valero-Cuevas

Background: The level of precision with which people can control their force depends on various factors such as visual error correction, proprioceptive feedback, and psycholog-

ical states. However, previous studies have focused on how individual factors affect the amplitude of force variability, and an integrative approach that quantifies their potential interactions is currently lacking. This gap is critical because all factors are often interdependent. **Purpose:** Here, we attempt to quantify such interactions by manipulating the amount of visual error information available to participants. **Methods:** We asked six male subjects to perform constant, isometric force production with their wrist flexors at 10% of their maximal voluntary contraction. They performed ten 15-s trials in random order for each of three visual feedback conditions, which differed in the amount of available visual information. **Results:** Consistent with previous findings, the amplitude of force variability is reduced in all subjects when the amount of visual error information is increased. However, there existed considerable inter-individual variability across conditions in measures of the sensitivity of proprioceptive feedback (as per physiological tremor) and the level of attention (as per heart rate). **Conclusion:** These results suggest that changes in force variability due to visual feedback manipulation are more directly related to visuomotor task requirements than the different psychological states that they induce. Also, these results confirm previous observations that individual participants may produce physiologically distinct responses to various types of visual feedback manipulation, which should serve as a springboard for future investigation to better understand precise control of force.

Poster #108

Title: Estimation of Patellar Tendon Stress Using Subject-Specific Finite Element Analysis

Authors: Kyung-Mi Park, Joyce H. Keyak, & Christopher M. Powers

Faculty advisor: Christopher M. Powers

Background: Patellar Tendinopathy (PT) is common among jumping athletes. Excessive patellar tendon loading has been considered the primary cause of PT. Although altered lower extremity biomechanics may contribute to PT, few studies have comprehensively examined the influence of lower extremity biomechanics in the context of patellar tendon stress. **Purpose:** To compare peak maximum principal stress (MPS) in the patellar tendon during single-leg landing task between a person with PT and a person without PT using 3D subject-specific finite element (FE) Modeling. **Methods:** Participants underwent biomechanical and MRI assessments. 3D subject-specific FE models of the tibiofemoral and patellofemoral joints were created, simulating the 3D knee kinematics at the time of peak knee extensor moment during single-leg landing. Patellar tendon stress was quantified as peak MPS which reflects the tensile stress that elongates the tendon. Peak MPS was identified within the region of interest. Elements that represented the bone-tendon interface were disregarded. **Results:** The peak MPS for the person with PT was 57.4 MPa and was located at posterior, proximal and medial part of the tendon. This is a common area of symptoms in persons with PT. For the control subject, peak MPS was 45.7 MPa and located at anterior, middle and medial part of the tendon. **Conclusion:** 3D subject-specific FE models that take into consideration lower extremity kinematics appears to be capable of differentiated those with PT from healthy controls. Future research will focus on determining the underlying biomechanical and anatomical predictor(s) of elevated patellar tendon stress in persons with PT.



Poster #109

Title: Preserved temporal coupling after right but not left hemisphere stroke

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

Faculty advisor: Carolee J. Winstein

Background: Little attention has been paid to hemisphere-specific deficits in bimanual control. **Purpose:** In this pilot study, we tested if interlimb temporal coupling, a well-studied empirical phenomenon (Kelso, 1979), is differentially influenced by the side of stroke lesion. **Methods:** Six right-hand dominant non-disabled adults and 2 chronic stroke survivors—1 left (LHD) and 1 right hemisphere damaged (RHD)—performed bimanual aiming movements to one or two visual targets in a frictionless 2D workspace without online visual feedback. In 8 experimental conditions, target distance was manipulated within 4 unimanual (6 and 14 cm for left and right hand) and 4 bimanual conditions. Bimanual conditions consisted of symmetric (6-6 and 14-14 cm for left and right hands) and asymmetric distances (6-14 with right hand moving to the far target, or, 14-6 with left hand moving to the far target). **Results:** We found that in non-disabled adults, for all bimanual conditions (symmetric and asymmetric), right-hand movements almost always started after the left hand, but both hands reached peak velocity synchronously. Right hand movements also always terminated after the left hand, except when the right hand traveled to the far target in the asymmetric condition. Participant with LHD showed large deviations from synchrony of the time-to-peak velocity for all bimanual conditions with the non-paretic hand always leading the paretic hand. Conversely, patient with RHD preserved coupling of this time-point. **Conclusion:** The left hemisphere might play a crucial role in synchronizing the temporal structure between hands during bimanual movements, which is disrupted by damage to the left hemisphere.

Poster #110

Title: Knee moments during squatting: influence of tibia and trunk orientation

Authors: Rachel K. Straub, Adam J. Barrack, Jordan Cannon, & Christopher M. Powers

Faculty advisor: Christopher M. Powers

Background: A long-held theory regarding squatting mechanics is that the knees should not pass the toes to minimize knee loading. However, it is also known that a forward trunk posture can lessen knee extensor demands. A limitation of previous studies in this area is that the influence of trunk or shank position has been studied in isolation. **Purpose:** To determine which segment (trunk vs shank) is most influential with respect to predicting the knee extensor moment during squatting. **Methods:** Kinematic and kinetic data were obtained from 16 participants during the execution of 8 different back squat conditions in which the tibia and trunk orientations were manipulated. Regression analysis was conducted to identify the individual relationships between the knee extensor moment and the trunk and shank, respectively. To identify the best predictor(s) of the knee extensor moment, stepwise multiple regression was implemented. **Results:** Increased shank orientation was associated with an increase in the knee extensor moment ($R^2 = 0.25$, $p < 0.001$). Conversely, increased trunk orientation was associated with a decrease in the knee extensor moment ($R^2 = 0.50$, $p < 0.001$). For stepwise regression, trunk orientation entered first and accounted for the greatest proportion of variance in the knee extensor moment, $R^2 = 0.50$. Shank orientation entered second, $R^2 = 0.53$, and explained an additional 3% of the variance. **Conclusion:** The trunk and shank have an opposing relationship with the knee extensor moment during squatting. However, sagittal plane trunk posture appears to be more influential.

Poster #111

Title: Impact of modifying spatiotemporal asymmetry on dynamic balance during walking post-stroke

Authors: Sungwoo Park, Chang Liu, Natalia Sánchez, Julie K. Tilson, Sara J. Mulroy, & James M. Finley

Faculty advisor: James M. Finley

Background: Neurological impairments such as stroke, often result in asymmetric walking patterns. It is often thought that reducing asymmetry may improve balance and reduce fall risk as spatiotemporal asymmetries are negatively correlated with clinical assessments of balance post-stroke. However, the acute effects of changing asymmetry on dynamic balance during walking have yet to be examined. **Purpose:** The goal of this work is to determine how manipulation of step length asymmetry influences dynamic balance during walking post-stroke. Dynamic balance can be measured by the whole-body angular momentum in the sagittal plane with respect to the body's center of mass representing the forward and backward body rotation. We hypothesized that participants would decrease WBAM when walking more symmetrically and increase WBAM when walking with exaggerated asymmetry. **Methods:** A total of 6 individuals post-stroke participated in this study and walked on a treadmill for three minutes each with and without visual feedback of their natural step length asymmetry. Next, they walked for three minutes each in a symmetric and exaggerated asymmetric condition. We measured the peak-to-peak range of WBAM over a gait cycle as metrics of dynamic balance. **Results:** Participants increased the peak-to-peak range of WBAM in both the symmetric and exaggerated asymmetry trials. This suggests that any deviations from their natural level of asymmetry reduced their dynamic balance. **Conclusion:** Our results suggest that the gait modifications necessary to reduce asymmetry may acutely impair balance control by increasing whole

body angular momentum.

Poster #112

Title: Cerebrovascular mechanisms of cognitive enhancement after periodized resistance Training

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

Faculty advisor: E. Todd Schroeder

Background: Resistance training (RT) is recommended for older adults for its putative role in the protection against sarcopenia, but its effects on brain health have been less-well studied. Demonstrating rapid health benefits following high-intensity RT may improve the clinical utility of such interventions for cognitive health. In addition, further investigations are necessary to understand the mechanisms that link skeletal muscle physiology and function with brain morphology and neuroplasticity. **Purpose:** The overall goal of this project is to investigate the effects of periodized RT on cognition and overall brain health in older adults. **Methods:** We will apply strength and conditioning principles and advanced neuroimaging techniques to a 12-week periodized RT intervention. The overall goal is to investigate changes in fluid cognition and cerebrovascular function in 23 healthy older adults 60-80 years of age, serving as their own controls, and explore the mechanisms that mediate these effects. The NIH Toolbox Cognition Battery and Arterial Spin Labeling (ASL) MRI will be used to assess changes in cognition and cerebrovascular function, respectively. Potential mechanisms of benefit, such as physical capacity, body composition, and blood marker levels, will be investigated for associations with brain adaptations. **Results:** One female pilot participant (68 years old) successfully completed the periodized RT intervention and all testing procedures without adverse events. Her fluid cognition composite score increased by 1.6

times the population standard deviation, while previous RT literature suggests a 0.68 mean effect size. Improvements in vascular compliance were promising. **Conclusions:** N/A

Poster #113

Title: Corticomotor excitability of gluteus maximus is associated with landing mechanics

Authors: Yo Shih, Beth E. Fisher, & Christopher M. Powers

Faculty advisor: Christopher M. Powers

Background: Inadequate use of the hip during functional tasks has been linked to knee injury. Altered motor control has been speculated to underlie this movement behavior. Transcranial magnetic stimulation (TMS) is a method that can probe the corticomotor excitability (CME) of the corticospinal pathway for a specific muscle and therefore is a method to investigate brain-behavior relationships. **Purpose:** To determine the association between CME of the gluteus maximus (GM) and the hip extensor moment (HEM) during single-leg drop-jump (SDJ). **Methods:** Thirty-two participants (17 females, 15 males) underwent TMS assessment of the gluteus maximus and biomechanical assessment of a SDJ. The peak slope of the input-output curve (IOC) of motor-evoked potential was used as the outcome measure of CME of GM. The average HEM during the stance phase of SDJ was calculated to represent the use of hip extensors. Pearson's product moment correlation was used to examine the association between the CME of the GM and the HEM. **Results:** Significant correlation was found between the peak slope of the IOC of GM and the average HEM during SDJ ($r=0.45$, $p=0.01$). **Conclusion:** The use of the hip extensors is associated with the strength of the descending neural drive along the corticomotor pathway of GM. This suggests that altered motor control may play a role in movement behavior thought to be contributory to knee injury.

BIOKINESIOLOGY & PHYSICAL THERAPY PHD STUDENTS

Poster #114

Title: Influence of Parkinson's disease on context-dependent locomotor learning in VR

Authors: Aram Kim & James M. Finley

Faculty advisor: James M. Finley

Background: People with Parkinson's disease (PD) deteriorate motor skill expression in different environmental contexts than practicing environments, even when the context is not directly relevant to the skill. This problem is referred to as context-dependent learning (CDL). Although people with PD demonstrate CDL during finger sequence learning, it is unclear whether people with PD exhibit CDL during locomotion.

Methods: Here, we used novel obstacle negotiation learning in VR to investigate CDL in people with PD and healthy adults. On Day 1, six participants with PD and older adults (HO) practiced stepping over 180 virtual obstacles viewed through a head-mounted display while walking on a treadmill. Participants were instructed to step over obstacles while achieving target foot clearance during crossing. Each obstacle was one of three heights and each height was associated with a range of foot clearance defining successful performance. We provided auditory feedback that scaled with the magnitude and direction of performance errors. On Day 2, participants completed retention tests in the same (SAME) and different (SWITCH) VR without auditory feedback. The SWITCH consisted of different colors of the environment. **Results:** The success rate during practice increased in both groups on Day 1, accompanied by decreases in error magnitude. On Day 2 in

the SAME, the PD group maintained the success rate. In the SWITCH, the success rate was reduced in the PD group while similar in the HO group compared to the SAME. **Conclusion:** Our results demonstrate that changes in environmental contexts may negatively influence locomotor skill learning in people with PD.

Poster #115

Title: Gluteus maximus activation improves hip biomechanics in femoroacetabular impingement syndrome

Authors: Jordan Cannon & Christopher M. Powers

Faculty advisor: Christopher M. Powers

Purpose: To determine if targeted gluteus maximus activation influences transverse plane hip kinematics and kinetics in persons with femoroacetabular impingement syndrome (FAIS) during a deep squat task. **Background:** Symptomatic bony impingement is thought to occur during activities in which the hip is flexed to angles greater than 90°. High hip flexion angles combined with hip internal rotation produce the highest contact pressures on articular surfaces. The gluteus maximus has been implicated as a muscle of interest in the FAIS population given its ability to produce hip external rotation during tasks requiring deep hip flexion. **Methods:** Kinematic, kinetic, and EMG data were collected from 3 patients with confirmed FAIS. Two different squat variations were performed. First, an unconstrained squat to maximum depth (self-selected stance width and foot position). Next, in the same unconstrained position, participants were instructed to increase gluteus maximus activation to approximately 15% of their maximum voluntary isometric contraction (MVIC). The hip internal rotation angle and hip external rotator moment were calculated at the point of maximum hip flexion. **Results:** Increasing gluteus maximus activation from 7.6% MVIC to 14.0% MVIC resulted in a reduction in peak

hip internal rotation (4° on average) and an increase in the hip external rotator moment (0.07 Nm/kg). **Conclusion:** These preliminary results suggest that cueing patients with FAIS to activate their gluteus maximus may be protective against femoroacetabular impingement and provide functional benefits in tasks requiring deep hip flexion.

Poster #116

Title: Determining brain-behavior changes secondary to an internal focus during standing

Authors: Alexander J. Garbin, Stephanie N. Yassa, & Beth E. Fisher

Faculty advisor: Beth E. Fisher

Background: Previous research has shown that adopting an internal focus of attention (IFA) results in a non-optimal neuromuscular pattern consisting of reduced motor cortical inhibition and increased muscle co-contraction during simple force production tasks. However, neither of these variables have been examined during a more ecologically valid task such as standing. IFA instructions are commonly utilized in clinical practice and the concomitant neural and biomechanical changes may lead to increased fall risk. **Purpose:** To characterize the neural (motor cortical inhibition) and biomechanical (co-contraction) changes following internal vs. external focus of attention (EFA) instructions delivered during different standing postures. Our results will support future work that aims to understand how focus of attention may impact older adults with an excessive concern of falling. **Methods:** 2 healthy adult participants stood with a narrow-base-stance or single-limb-stance while being instructed to stand quietly with an IFA or EFA. While standing, motor cortical inhibition was quantified via the combined use of peripheral electrical stimulation and transcranial magnetic stimulation. Co-contraction index was measured via elec-

tromyography placed on the Soleus and Tibialis Anterior of the dominant limb. **Results:** In our participants, adoption of an IFA resulted in reduced motor cortical inhibition relative to adoption of an EFA during narrow and single-limb-stance. Furthermore, the participants exhibited greater co-contraction while focusing internally during single-limb-stance. **Conclusion:** Our preliminary findings suggest that adoption of an internal focus of attention may reduce cortical inhibition and increase lower extremity muscular co-contraction during stance, particularly in the most challenging standing posture.

Poster #117

Title: Identifying predictive gaze in infants using head mounted eye tracking

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

Faculty advisor: Beth A. Smith

Purpose: Our purpose is to propose a methodology for identifying predictive gaze in infants using head mounted eye tracking during a contingency learning task. Our goal is to identify whether or not infants demonstrate predictive gaze when they learn a motor task. **Methods:** Twelve infants participated in a contingency learning task where movement of their right leg resulted in a robot kicking a ball with its left leg. Head mounted eye-tracking (Positive Science) was used to estimate the position of the infant's gaze throughout the task. Trained interns coded where the infant was looking through a frame-by-frame analysis of the video data (Elan). In addition, infants were categorized as learners if they demonstrate a leg movement frequency of 1.5 times greater in the contingency phase of the task compared to the baseline. Proposed Method for Identifying Predictive Gaze: First, we will identify a stable gaze as 3 frames (0.1s) of no eye movement. Then, we will identify predictive versus non-predictive gazes. A predictive gaze is defined as having a stable

gaze on the reward stimuli prior to its activation. All other gazes are defined as non-predictive. **Results:** For each infant, we will determine if infants who learned the task used predictive gaze based on our criteria. **Conclusion:** Detection of predictive gaze using head mounted eye tracking appears feasible. To date, 3 coders have coded 1 video using the gaze definitions described here and we are assessing inter-rater reliability. Our next step is to finalize our gaze definitions.

Poster #118

Title: Exertion from dance creates phase-specific alterations of interlimb force coordination

Authors: David Ortiz, Hai-Jung Steffi Shih, Amanda Yamaguchi, & Kornelia Kulig

Faculty advisor: Kornelia Kulig

Background: To date, coordination studies featuring the lower extremity have only investigated reciprocal motion. It is vital not to overlook the importance of bipedal coordination patterns at the whole limb level. A recent study delved into this area by analysing interlimb ground reaction force (GRF) coordination pattern differences between dancers and non-dancers. Compared to non-dancers, dancers displayed more tightly controlled coordination of the forces during the transition phase of sautés, which was critical to performance. **Purpose:** This preliminary study investigates how GRF coordination during sautés, a rate-controlled dance jump, changes due to exertion. **Methods:** Vector coding was used to analyse interlimb force coordination during ground contact, which was subdivided into three phases. Coupling angle between bilateral ground reaction forces was determined and coupling angle variability (CAV) was calculated via circular standard deviation. In this analysis, CAV is the jump-to-jump variability of the relative magnitude of force between limbs at successive time points. Therefore, it characterizes fluctuations in interlimb force coordination within each series of sautés. **Results:** A significant increase in CAV during weight acceptance was found in the post-exertion series of sautés compared to the series before performing choreography (ES = 0.50). There was no difference in transition phase CAV (ES = 0.03) or propulsion phase CAV (ES = 0.19). **Conclusion:** After exertion, dancers demonstrated a more variable interlimb force coordination only during weight acceptance. We suggest that the increased coordination variability during weight acceptance is tied to the need to retain consistent interlimb coordination in the performance-determining transition phase.

dination within each series of sautés. **Results:** A significant increase in CAV during weight acceptance was found in the post-exertion series of sautés compared to the series before performing choreography (ES = 0.50). There was no difference in transition phase CAV (ES = 0.03) or propulsion phase CAV (ES = 0.19). **Conclusion:** After exertion, dancers demonstrated a more variable interlimb force coordination only during weight acceptance. We suggest that the increased coordination variability during weight acceptance is tied to the need to retain consistent interlimb coordination in the performance-determining transition phase.

Poster #119

Title: The influence of gait speed on sagittal plane knee mechanics post-ACLR

Authors: Meagan Chow, Carole Gong, & Susan Sigward

Faculty advisor: Susan Sigward

Background: Following anterior cruciate ligament reconstruction (ACLR) individuals exhibit asymmetric sagittal plane mechanics during gait; characterized by decreased knee extensor moments (KextMmt) in surgical (SX) limb. This strategy present during early rehabilitation persists long term. This is problematic as underloading is attributed to progression of knee osteoarthritis. As such they are considered maladaptive. Their permanence suggests current rehabilitation protocols don't restore knee mechanics. Manipulation of gait speed increases knee loading in healthy individuals; however, it is not known how speed influences knee loading or symmetry following ACLR. **Purpose:** Determine effects of gait speed on KextMmt and between limb symmetry. **Methods:** 6 Individuals following ACLR (5months - 8years) walked on an instrumented treadmill with 2 force platforms (age: 24.3±1.2, sex: 5F). Participants walked at self-selected speed (SS), 2 slower and 2 faster speeds in 25% increments: SS-50%, SS-

25%, SS+25%, and SS+50% for 2minutes at each speed. Data were collected during last 30 seconds and analyzed for 6 strides per limb. KextMmt were calculated during loading response of gait. Between limb symmetry indices were calculated as (peak knee extensor moment SX)/(peak knee extensor moment NSX). Effect sizes (ES) were calculated to estimate magnitude of mean difference between conditions. **Results:** Increased KextMmt at faster speed (ES_SX:1.18, ES_NSX:1.37), decreased KextMmt at slower speed (ES_SX:2.18, ES_NSX:2.19) in both SX and NSX knees. Knee loading symmetry improved at faster speeds (ES:1.65). **Conclusion:** Faster gait speed on treadmill increases knee loading for each limb and between limb knee loading symmetry following ACLR.

Poster #120

Title: Adherence to a home exercise program to encourage leg movements

Authors: Weiyang Deng, Marcelo Rosales, & Beth A. Smith

Faculty advisor: Beth A. Smith

Purpose: Our purpose here is to report adherence to a daily caregiver-provided intervention to encourage infant leg movements in infants at risk for developmental disability. **Methods:** Six infants with a median adjusted age of 204 days at the first visit participated (min: 84, max: 271). We worked with caregivers to determine a daily exercise program to encourage increased amount and variability of infant leg movements (goal = 2 exercises, 3-5 times each day, 3-5 minutes each time). Adherence was operationally defined as percentage of completed days (number of days when the total time of the prescribed intervention was met divided by the total number of possible days) and percentage of completed time (total time completed divided by prescribed time) using logbooks kept by caregivers. **Results:** All infants received 2 to 5 visits, at monthly intervals. Mean (stan-

dard deviation, (SD)) amount of caregiver provided intervention was 43.41 (±28.39) minutes per day. The mean (SD) percentage of completed days was 75.1% (±31.5%). Mean (SD) of percentage of completed time was 151.1% (±94.3%). **Conclusion:** Our average time of 43 minutes provided per day is similar to a previous infant intervention study (Morgan et al, 2016). So far, some families have completed much more than the prescribed intervention while others have completed much less than prescribed. These are preliminary results, as our goal is 12 infants. Next steps include completing data collection and testing the effectiveness of the intervention.

OTHER BIOKINESIOLOGY & PHYSICAL THERAPY RESEARCHERS

Poster #121

Title: Trunk and tibia orientations influence hip/knee moment ratios during squatting

Authors: Adam J. Barrack, Rachel K. Straub, Jordan Cannon, & Christopher M. Powers

Faculty advisor: Christopher M. Powers

Background: Sagittal plane trunk and shank orientations have been shown to independently modulate extensor moments at the hip and knee in the barbell back squat. However, the relative influence of trunk and tibia orientations on the muscular demands of the hip and knee extensors is unknown. **Purpose:** To determine if the relative orientation of the trunk and tibia in the sagittal plane (TR-SH) can be used to approximate the relative demand of the hip and knee extensors across a wide range of squatting techniques. **Methods:** Kinematic and kinetic data

were obtained from 8 male and 8 female participants during the execution of 8 different squat conditions in which tibia and trunk orientations were manipulated. Foot position, bar position, bar load, and stance width were controlled. The hip/knee extensor moment ratio (HKR) at 60 and 90 degrees of knee flexion was calculated using inverse dynamics. Linear regression was used to evaluate the association between independent and dependent variables. **Results:** Across all squat conditions, TR-SH explained 67% and 71% of the variance in the HKR at 60 degrees ($p < 0.001$) and 90 degrees ($p < 0.001$) of knee flexion, respectively. The squat was deemed to be hip extensor biased (HKR > 1.0) when the sagittal plane trunk angle exceeded the sagittal plane shank angle for both examined depths. **Conclusion:** The relationship between sagittal plane trunk and shank orientation can be used as an acceptable inference as to whether a particular squat technique is hip extensor biased or knee extensor biased.

Poster #122

Title: Effect of a golf intervention on center of pressure control

Authors: Jared L. Moore, Andrea M. DuBois, Nicole Marcione, Hyun J. Lee, Steven C. Castle, & George J. Salem

Faculty advisor: George J. Salem

Background: Aging is associated with decreased balance which is in turn associated with increasing fall risk. Impaired balance can be shown through alterations in center of pressure (COP) control in the medio-lateral (ML) and anterior-posterior (AP) directions. Golf is a multimodal, dynamic activity that encompasses a wide range of movement patterns and could help improve balance. **Purpose:** The purpose of this study was to investigate COP range and mean velocity changes in the ML and AP directions following a golf intervention in older, military veterans. **Methods:** COP was

measured in nine older, military veterans while completing a semi-tandem balance task. COP range and mean velocity were calculated for the ML and AP directions. **Results:** All participants were able to stand for the maximum of 30 seconds on all trials. There were no significant differences from baseline to post testing for COP range or mean velocity in the ML or AP direction. There were varied individual participant results, however, most did not change from baseline. **Conclusion:** Golf is a multimodal, dynamic activity that may have more pronounced effects on a dynamic balance task than the static balance task used in this study. Little time is spent controlling balance in quiet standing during golf, which may explain why no changes were seen in COP range or velocity during a semi-tandem balance task. Future studies should investigate changes in dynamic balance following a golf intervention and/or more challenging static balance tasks.

Poster #123

Title: Association between bone resorption biomarkers and body fat percentage in overweight and obese breast cancer survivors

Authors: Kaylie Zapanta, Kyuwan Lee, Nathalie Sami, & Christina M. Dieli-Conwright

Faculty advisor: Christina M. Dieli-Conwright

Background: Obesity-induced reductions in osteocalcin and bone-specific alkaline phosphatase (BSAP) are associated with bone resorption and degradation. Therefore, obese individuals with high body fat (BF) may experience reductions in bone mineral density (BMD) and increased risk of fracture. Breast cancer survivors (BCS) often experience increased BF due to cancer treatments, thus may be more susceptible to bone resorption than non-cancer populations. **Purpose:** The purpose of this study was to determine whether BF was associated with osteocalcin and BSAP in overweight/obese BCS. **Methods:** One hundred

sedentary, overweight/obese BCS (BMI ≥ 25 kg/m²; Stages I-III) were included. Body fat percent was obtained from a whole-body scan using the Dual Energy X-Ray Absorptiometry (DEXA; Lunar GE iDXA, Fairfield, Connecticut). Osteocalcin and BSAP were measured using enzyme-linked immunosorbent assays from fasting blood samples. Pearson's correlations were used to assess the association between body fat percent and each bone biomarker. **Results:** The BCS were 53.5 ± 10.4 years old, postmenopausal (60%), Hispanic (55%) with a BMI of 33.5 ± 5.5 kg/m². Mean values for BF and bone resorption biomarkers were as follows: BF $36.9\% \pm 4.9$, osteocalcin 12.2 ± 3.25 ng/ml, and BSAP 16.15 ± 4.5 ng/ml. There were strong correlations between BF and osteocalcin ($r = 0.723$; $p < 0.001$) and between BF and BSAP ($r = 0.819$; $p < 0.001$). **Conclusion:** BF was associated with bone resorption biomarkers in overweight and obese BCS. Therefore, high BF may further contribute to poor bone health caused by cancer-related treatments. Targeting BF with lifestyle interventions may be important to consider during cancer survivorship, in order to improve bone health among overweight/obese BCS.

Poster #124

Title: Reducing gait asymmetry post-stroke: A feasibility and preliminary efficacy study

Authors: Lauri Bishop, Isirame Omofuma, Joel Stein, Sunil Agrawal, & Lori Quinn

Faculty advisor: Carolee J. Winstein

Background: Gait asymmetries are common after stroke and often persist despite conventional rehabilitation. Robots provide training at a greater intensity than conventional approaches. However, after robotic training, the user is often unable to transfer learned skills outside of the device. The tethered pelvic assist device (TPAD) promotes weight shifting yet allows users to independently navigate

spatiotemporal aspects of gait. **Purpose:** The purpose of this study was to evaluate feasibility and preliminary efficacy of a five-day intervention that combined TPAD training with visual feedback and task-specific overground training to promote improved force and stance symmetry in individuals post stroke. **Methods:** After baseline assessments, participants received one-hour of practice for five consecutive days. Training sessions included visual feedback during TPAD treadmill training followed by overground gait training. Load and stance symmetry were reassessed after the intervention (Post-Training) and again one-week later (Follow-up). Safety, perceived exertion, and adherence were also recorded. **Results:** No adverse events were reported. Mean (SD) of perceived exertion (3.61 (0.23)) was low and did not significantly change throughout the intervention. Overall adherence was 96.4%. Load asymmetry was not significantly reduced on the treadmill from Baseline to Post Training ($p > 0.05$). Overground stance symmetry ($F = 8.498$, $p = 0.002$) significantly improved on Post Training but was not sustained at Follow Up. **Conclusion:** Results demonstrate that this combined intervention was feasible. Despite limited gains in load symmetry on the treadmill, individuals improved stance symmetry overground, an indication that this paradigm was effective in improving walking performance measured immediately after training.

Poster #125

Title: Osteogenic response after six months of high-intensity, low impact exercise

Authors: E. Todd Schroeder, Alberto F. Vallejo, & Malcolm Jones

Background: Lagree Fitness exercise offers high-intensity, low impact workouts that combine resistance, endurance, and core training on pilates machines. This is an alternative to traditional weight bearing resistance training; however, it's unknown whether this training method has osteogenic effects

on bone similar to traditional resistance training. **Purpose:** To provide insight, we assessed changes in bone after six months of the high-intensity La-gree training in men and women. **Methods:** 31 healthy participants, began a 6 month, 3x per week, 25 minute group training course. Participants completed lumbar spine, bilateral hip, total body bone, and total body soft tissue scans on a GE Lunar iDXA at baseline. 23 participants complied with the training commitment necessary to receive post training iDXA scan within 10 days of completing 72 training sessions. Therefore, we analyzed data from 19 women and 4 men (45.1 ± 20.9 year of age), weight (150.5 ± 41.5 lb), height (66.5 ± 6.5 in) who received both scans. **Results:** There were significant changes (Leg BMC: $p=0.035$) or changes that approached significance (Arm BMD: $p=0.125$) in bone that accompanied significant increases in muscle (Arm LMT: $p=0.009$) or increases in muscle mass that approached significance (Total LMT: $p=0.069$). **Conclusion:** These changes could be promising for the total body, the legs, and the arms; however, a study with more participants is necessary to confirm this. For this protocol, in this sample, there were no significant osteogenic effects on the hips and lumbar spine typically of importance in osteopenic populations.

Poster #126

Title: Hip & trunk coordination during cutting maneuvers in skilled athletes

Authors: Richard Mercer, Kathryn Havens, & Susan Sigward

Faculty advisor: Susan Sigward

Background: Large differences are observed in frontal plane kinematics and kinetics at the hip but not the trunk when cutting to different angles, which suggests coordination of hip and trunk mechanics is angle specific. **Purpose:** This study quantified coordination between the frontal plane hip and trunk kinematics during cutting

to 45 and 90°. **Methods:** Kinematics were calculated using standard three-dimensional motion analysis procedures. Twenty-five healthy soccer players performed sidestep cuts as fast as possible to 45 and 90°. Inter-joint coordination was quantified from joint angle-angle plots using vector coding. Coordination was classified into patterns (anti-phase, in-phase, proximal, or distal phase) at each point across stance. The frequency of each pattern was identified during 0-35%, 36-75%, and 76-100% of stance. Median rank differences in frequency were compared between cut angles for each phase using Wilcoxon signed-rank tests ($\alpha \leq 0.05$). **Results:** Lesser proximal coordination (during 0-35%), lesser in-phase coordination (during 36-75%), and greater in-phase and lesser anti-phase coordination (during 76-100%) were observed for 45 compared to 90°. **Conclusion:** Previous data suggests that the hip may play a different role during cutting to smaller and larger angles and illustrate a differing pattern of engagement in the frontal plane. These data suggest that different coordination patterns are employed to achieve the increased demands of cutting to greater angles.

Poster #127

Title: Characterization of sagittal plane demands during a triple hop task

Authors: Nicole Schwery, Sara Almansouri, Neama Neamat, & Susan Sigward

Faculty advisor: Susan Sigward

Background: Clinical hop tests use distance hopped as metric for recovery after knee injury. Given that it is a multi-joint task it may not be sensitive to deficits in knee mechanics. **Purpose:** To understand the demands across the joints this study compared ankle, knee and hip sagittal plane mechanics during a triple hop task. **Methods:** Kinematics and kinetics were collected on 81 healthy female athletes using 3D motion analysis. Range

of motion (ROM), extensor moment impulse (exMI), power absorption (pAb) and generation (pGn) were calculated during deceleration (foot contact to peak knee flexion) and propulsion (peak knee flexion to toe-off) phases of the second hop. Three trials were averaged. **Results:** Mixed design MANOVA was used to compare kinematics and kinetics between joint (ankle, knee and hip) and phase (deceleration and propulsion). During deceleration, ROM and pAb was greatest at knee than hip ($p < 0.00$) and ankle ($p < 0.00$). extMI was greatest at knee and hip than ankle ($p < 0.00$). During deceleration, ROM was greater at knee (36.2 ± 6.4) than hip (11.3 ± 3.6 ; $p < 0.00$) and ankle (29.3 ± 9.5 ; $p < 0.00$). extMI was greater at knee ($.24 \pm .08$; $p < 0.00$) and hip ($.26 \pm .09$; $p < 0.00$) than ankle ($.19 \pm .06$). Knee pAb ($.83 \pm .30$) was greater than ankle ($.70 \pm 0.3$; $p = 0.04$) and hip ($.30 \pm .2$; $p < 0.00$). During propulsion, knee ROM (34.5 ± 7.7) was greater than ankle (14.7 ± 8 ; $p < 0.00$). extMI was different between all joints ($.31 \pm .05$, $.19 \pm .05$ and $.08 \pm .07$, ankle, knee and hip, respectively; all $p < 0.00$). **Conclusion:** The triple hop is a multi-joint task limited to interpretation of overall limb performance. The dominant role of the ankle during the propulsion phase may allow for similar hop distances despite knee impairments.



OCCUPATIONAL SCIENCE & OCCUPATIONAL THERAPY FACULTY

Poster #128

Title: Infants at risk for ASD: early intervention focus group findings

Authors: Emily Schulze, Lauren Teague, & Grace Baranek

Background: Early signs of autism spectrum disorder (ASD) can be identified in children as young as 6-9 months, but only 42-55% of pediatricians screen for ASD during the first 2 years. Occupational therapists (OTs) often work with young children with various neurodevelopmental conditions, including children showing signs of ASD despite other reasons for referral. Thus, OTs are well positioned to initiate ASD screening. **Purpose:** 1) Understand the role of OTs in identifying and intervening with infants and toddlers at risk of ASD; 2) Learn about OTs' confidence in their knowledge of best practices on early identification and intervention for ASD; 3) Determine the readiness and capability of OTs within early intervention (EI) to utilize ASD screening tools clinically. **Methods:** Two semi-structured 90-minute focus groups were conducted with 13 Los Angeles-based OTs (inclusion: ≥ 1 year of clinical EI experience). Focus groups were audio recorded, transcribed, and analyzed using a hierarchical coding scheme. **Results:** Three themes emerged. First, participants had varying understandings of the difference between screening and diagnosis of ASD, often using the terms interchangeably. Second, participants collectively expressed pride in OT's versatile role on EI teams, which allows them to address family needs unmet by other providers. Lastly, participants shared personal-, provider-, and system-level barriers to addressing ASD in EI. **Conclusion:** To support the role of

OTs in early ASD screening, further research is needed on how to mitigate barriers to service delivery, bolster education on screening procedures, and capitalize on the fluid nature of OT in EI practice.

Poster #129

Title: Lessons learned from in-home user testing of a dynamic seating system prototype

Authors: Stacey L. Schepens Niemiec, Matthew Niemiec, Eliana Bendetson, & Roger Leib

Background: Older adults spend 80% of their day sitting, a behavior strongly linked to chronic disease. *Activ Sitting, Inc.* has proposed a dynamic seating system—*FitSitt*—that facilitates stepping movements to interrupt sedentariness, is usable across the entire day, and is versatile for placement in any room. In vivo, prototype testing is recommended to gain insight into product usability and acceptability prior to full-scale development. **Purpose:** Discuss the challenges and lessons learned from early-stage, in-home user testing of the first *FitSitt* prototype. **Methods:** Seven older adults (5 females; \bar{x} age=74.6) tested the *FitSitt* prototype for 48 hours in home. Chair placement was selected based on participants' sitting routines and available space. Participants were fitted to the chair and oriented to its features. A follow-up interview was conducted after two days. **Results:** Several challenges, organized by theme, arose from in-home prototype testing. In-the-wild environment: without the control afforded by a laboratory, data collection quality and accuracy was variable. Transportability: component parts were unstable and bulky due to early-stage development. Functionality: *FitSitt* did not yet include all functioning components, which constrained participants' evaluation of the envisioned product. Single prototype availability: having only one prototype prolonged user testing and required extensive logistical planning. **Conclusion:** Despite the value of

gathering user data in an ecologically valid context, several challenges arose in evaluating a dynamic seating system prototype for older adults. Lessons learned from this process will drive further testing and development of *FitSitt* and can be applied to other studies of health device development.

OCCUPATIONAL SCIENCE & OCCUPATIONAL THERAPY DOCTORAL STUDENTS

Poster #130

Title: Sensory differences in infants at risk for neurodevelopmental disorders

Authors: Allison Phillips & Grace Baranek

Faculty advisor: Grace Baranek

Background: Sensory dysfunction is often associated with negative outcomes for children with neurodevelopmental disorders (ND), including those with autism spectrum disorder (ASD). Studies show that sensory systems are fully functional at birth, with sensory development beginning in utero and continuing throughout our lifetime, with special significance throughout the first few years of life. Sensory systems allow infants to make sense of the world around them, interact with their environment, and interpret input to inform actions. Early sensory development is critical to later development of higher order functions, such as language and cognition in infants. **Purpose:** To review current literature examining early sensory development among infants considered at risk for ND, particularly preterm and infants with a sibling diagnosed with ASD, as compared to a normative sample. **Methods:** A literature search was conducted using Google Scholar

and PubMed with search terms such as: infant, sensory, development, at risk, autism, and processing. **Results:** Twelve studies met the inclusion criteria (at risk infants between 0 and 24 months of age). The literature suggests that at risk infants exhibit greater tactile defensiveness as well as increased difficulty with auditory and visual processing. Differences in sensory reactivity can have progressive and cascading effects on infants' occupations, with high risk infants displaying greater challenges with sleeping, feeding, and adaptive motor skills. **Conclusion:** At risk infants display difficulties with modulation of tactile, auditory, and visual processing which impact everyday occupations.

Poster #131

Title: A preliminary usability evaluation of a physical activity smartphone application for older adults.

Authors: Britney Cariño, Jeanine Blanchard, & Stacey Schepens Niemiec

Faculty advisor: Stacey Schepens Niemiec

Background: Sedentariness in older adults is associated with chronic disease and poor health outcomes. Commonly employed approaches to increase physical activity (PA) in seniors rarely translate into long-term behavior change. Using smartphone apps to boost older adults' PA remains largely untapped despite potential to improve PA engagement. **Purpose:** To examine the usability of features comprising a PA app prototype for older adults. **Methods:** A convenience sample ($n=13$; 12 female; \bar{x} age=71.9) of underactive older adults was recruited from independent-living communities. Participants were assigned one specialty feature and a core activity-tracking component to beta test for two weeks. Specialty features addressed sedentary activity, aging views, or PA knowledge and barriers. Participants' evaluations of app components were assessed at

follow-up using the Health Information Technology Usability Evaluation Scale (HITUES) tailored to their assigned feature and via focus group interviews (arranged by specialty feature). **Results:** Using a five-point Likert (strongly disagree=1; strongly agree=5), participants' combined overall ratings ($M\pm SD$) of feature usability on HITUES dimensions were: impact (3.6 ± 1.3), usefulness (3.5 ± 1.3), ease of use (4.6 ± 0.7), and control (3.8 ± 1.2). Participants reported confidence operating the app, increased self-awareness of sedentary behaviors, and feeling inspired to integrate PA into daily life. The feature addressing PA knowledge and barriers was rated highly on potential for long-term impact (4.7 ± 1.0). Requested improvements included clarity of instructions, feedback on errors, and flexibility to accommodate specific needs. **Conclusions:** Participants were satisfied with overall app usability but noted various functionalities requiring improvement. User feedback will support continued app refinement in preparation for large-scale testing.

Poster #132

Title: Dynamic evaluation of median nerve shape in the carpal tunnel

Authors: Buwen Yao, Kayla Gan, Annie Lee, & Shawn C. Roll

Faculty advisor: Shawn C. Roll

Background: Using sonography, we can identify median nerve (MN) shape, sliding and changes that occur during gripping/pinching. These factors may be related to chronic nerve injuries; however, limited evidence exists regarding this association. **Purpose:** To identify the shape, sliding and dynamic changes of the MN and explore associations with demographic characteristics. **Methods:** The MN of 169 healthy volunteers was evaluated with sonographic imaging. Shape of the MN was recorded in three categories during resting, grip-

ping, and pinching as ovoid, angular, or irregular. Amount of nerve sliding during gripping was qualitatively categorized into three levels. The associations between these factors and demographic data were analyzed using Chi-square tests. **Results:** Participants were primarily female (84.6%) with an average age of 24.6 years and average BMI of 23.3 kg/m². During gripping, 74.3% of participants experienced a shape change in the MN. The proportion of MN ovoid shape in resting (43.6%) decreased to 23.0%/27.1% during gripping/pinching, and angular shape increased from 34.2% to approximately 50%. Sliding in about half of MNs was independent of surrounding tendons. Hispanics had higher frequency of ovoid MN in the non-dominant hand than irregular/angular shapes as compared to non-Hispanics ($p = 0.020$). Participants who were overweight/obese had no/less sliding movement of the MN than did participants in other BMI ranges ($p = 0.016$). **Conclusions:** Functional hand use produced shape changes and compression on the MN. Ethnicity was associated with shape, while BMI was associated with amount of MN sliding. Identifying individual MN changes may assist in predicting injury risk.

Poster #133

Title: Occupation, sleep hygiene, and neural connectivity in autism spectrum disorder

Authors: Christiana Butera, Emily Kilroy, Cristin Zeisler, Sharada Krishnan, Gina Gosparini, Laura Harrison, & Lisa Aziz-Zadeh

Faculty advisor: Lisa Aziz-Zadeh

Background: Sleep problems are common in children with autism spectrum disorder (ASD) and insufficient sleep exacerbates the severity of ASD symptoms (Park et al., 2012). Sleep quality impacts neural networks, including the default mode network (DMN; De Havas et al., 2012), which is important for elements of occupation-

al engagement (Mak, 2017). **Purpose:** This study assesses how participation in sport occupations correlates with sleep hygiene and DMN connectivity in typically developing (TD) children, and children with ASD and developmental coordination disorder (DCD). **Methods:** Data from 24 participants ages 9-15 were analyzed. The Child Behavior Checklist (CBCL; Achenbach, 1991) was qualitatively coded for sport occupations. Responses were compared across groups and related to Family Inventory of Sleep Habits (FISH; Malow et al., 2009) scores. DMN seed connectivity analysis from resting-state functional magnetic resonance imaging (fMRI) data were correlated with FISH scores. **Results:** The ASD group had higher mean FISH scores than the TD group, although this difference was not significant ($p=0.08$). Forty percent of participants identified swimming as a preferred sport, and these participants had significantly higher FISH scores than those who did not name swimming ($p=0.03$). In the ASD group, FISH scores were positively related to connectivity of regions of the DMN ($p<0.05$). **Conclusion:** Participants who reported swimming as a preferred sport demonstrated significantly higher FISH scores than non-swimmers. In the ASD group, higher FISH scores were associated with increased DMN functional connectivity. Results provide an implication for a relationship between swimming, sleep, and neural connectivity in ASD. Data collection is ongoing.

Poster #134

Title: Patterns of attention to non-social stimuli in children with autism spectrum disorder

Authors: Claire Yun-Ju Chen, Clare Harrop, Maura Sabatos-DeVito, John Bulluck, & Grace Baranek

Faculty advisor: Grace Baranek

Background: Aberrant attention patterns in autism spectrum disorders (ASD) have

been widely reported. However, the impact of low-level sensory features (e.g., motion, modality) on attention patterns toward non-social stimuli in ASD has not been comprehensively studied. **Purpose:** We aimed to examine 1) how the sensory properties of non-social stimuli impact the allocation of attention; 2) how patterns of attention associate with clinical sensory profiles. **Methods:** Forty children with ASD, typically development (TD), or developmental delay (DD) ages 4 to 13 years were included. Parents reported child's sensory response patterns via the Sensory Experiences Questionnaire, v3.0. Children completed a passive-viewing eye-tracking task designed to measure attention to non-social stimuli; six novel objects with interesting visual and auditory qualities were presented. **Results:** Fixation durations were longer for stimuli with motion/sound in ASD and TD. No condition effect for the number of fixations; however, ASD fixated significantly fewer times than DD and TD across conditions. ASD and TD fixated longer at spinning items. Significant associations were found between hyperresponsiveness and attention under various stimulus conditions in ASD after correcting the moderation effect of hyporesponsiveness. **Conclusions:** Stimuli with extra sensory features produced facilitatory effects on visual attention for all groups. Children with ASD generally fixated fewer times and longer, indicating "sticky attention." In contrast, children with DD looked at the objects more briefly and frequently regardless of the spinning feature. Hyperresponsiveness seems to associate with the aberrant attention patterns in ASD, while other factors (e.g., cognition) may be taken into account in developmentally-delayed children.



Poster #135

Title: Relationships between therapist and client actions during sensory integration therapy

Authors: Cristin M. Holland, Erna I. Blanche, & Barbara L. Thompson

Faculty advisor: Grace Baranek

Background: Sensory integration therapy (SIT) is widely employed by occupational therapists (OTs) for clients with autism spectrum disorder (ASD), and research provides support for SIT as an effective intervention for improving sensory-related and functional difficulties. However, research on therapists' activities in relation to clients' behaviors has been limited to small time increments during intervention sessions. **Purpose:** The goal of this study was to investigate relationships between child outcomes and therapist behaviors during SIT. **Methods:** SIT intervention sessions involving OTs ($n=7$) and their clients ($n=9$) aged 18 to 60 months with ASD were videotaped in two Los Angeles area occupational therapy clinics. Videotapes were analyzed retrospectively using continuous sampling behavior coding with Observer XT 14.1. Individualized coding schemas were created in collaboration with SIT experts for child (190 behaviors relevant to sensory processing, ASD symptomology, and general impression scores) and therapist (140 behaviors related to facilitated activities, social interactions, and general impression scores on therapeutic modes and type of play). Pearson correlations were employed to explore relationships between child improved outcomes and therapist behaviors during intervention. **Results:** Child eye contact and shared affect, social reciprocity, and engagement were positively correlated with therapist feedback and behaviors that promoted challenge, problem-solving or planning. Child engagement and social reciprocity were positively correlated with collaboration between client and therapist. **Conclusion:** Results indicate impor-

tance of the therapist-child alliance, and suggest that the “just right challenge” is critical to child engagement. Results can help guide therapists’ activities and therapeutic use of self during intervention to enhance outcomes.

Poster #136

Title: The anatomy of oral care habits of children with autism spectrum disorders

Authors: Dominique H. Como, Daniella C. Floríndez, Sharon A. Cermak, & Lucía I. Floríndez

Faculty advisor: Sharon A. Cermak

Background: Dental care is the most prevalent unmet health need in the US. Under-represented and underserved groups (i.e., Latinos, Autism Spectrum Disorders (ASD)) are at increased risk for oral health disparities. Little research centers on factors like diet, culture, systemic barriers that contribute to successful home-based oral care and that may affect oral health. **Purpose:** To explore the factors that serve as barriers or facilitators to oral care practices of Latino children with Autism (cASD). **Methods:** This qualitative study of Latino families with cASD (6-12 years) (n=10) included interviews to identify the factors influencing oral health, videos of the child’s oral care routines, and a photo food journal of the child’s meals. Interviews were transcribed verbatim and thematically analyzed, videos were blindly coded, and photos were analyzed for content and overlapping food patterns. **Results:** The interviews yielded three themes: “Estoy sola” described parents’ feelings of isolation, “Wait, there’s more” portrayed tooth-brushing as the only routine often performed by the child, and “It’s a Battle” described parents relationship with their child’s oral care habits due to disagreements related to enforcing self-care activities. Two themes pertaining to oral care practices were observed in the videos: Parents-as-Partners who facilitate activities and Modifications described changing

the environment or activity to meet the child’s needs. Lastly, the food journals revealed that cariogenic beverages were consumed more frequently than water. **Conclusion:** This research is novel in considering the influence of culture, family, diet, performance patterns and systemic restrictions on oral care practices for Latino cASD.

Poster #137

Title: A scoping review of social stories for individuals with autism

Authors: Delaney Hudak, Dominique H. Como, Margaret Goodfellow, & Sharon A. Cermak

Faculty advisor: Sharon A. Cermak

Background: Social stories are a widely used intervention for individuals with Autism Spectrum Disorders (ASD) and have been shown to be successful in decreasing inappropriate behaviors and increasing academic abilities, social skills, and participation in self-care activities. While there have been a number of reviews evaluating the quality and efficacy of social story interventions for individuals with ASD, the results of previous publications have highlighted the disparate outcomes of social story research. **Purpose:** To systematically evaluate, identify, and synthesize studies utilizing social story interventions targeting behavior change in individuals with ASD. **Methods:** A search of five databases targeting social stories was conducted and articles with population term- [(Autis* OR ASD OR Asperger*)] AND intervention term- [(“Social Stories” OR “Social Story” OR Social Narrative)] were considered. Article titles, abstracts, and full texts were independently reviewed by two reviewers; a third reviewer assisted during conflicts until consensus was met. **Results:** The systematic search produced 450 abstracts, with 88 articles meeting inclusion criteria. Primary outcomes of each study were sorted into one of two macro-categories based

on their outcome: Reduce Disruptive Behaviors (37.5%) and Increase Desired Behaviors (62.5%). The overwhelming majority of the studies (86%) were single-subject case study and multiple baseline designs, five were randomized control group studies and six were a hybrid study design. Of those, thirty-one studies (35%) were doctoral dissertations. **Conclusion:** The studies provide evidence that social stories are feasible and effective in facilitating positive social interactions, promoting independence and regulation, and eliciting behavior change for individuals with ASD.

Poster #138

Title: Weekly calendar planning activity: validity in college-aged students

Authors: Eddie Chu, Margaret Goodfellow, Rashelle Nagata, Amy Yeh, Ty Kim, & Sharon A. Cermak

Faculty advisor: Sharon A. Cermak

Background: Executive functions (EF) are the cognitive skills necessary for performance of goal-directed tasks. They are critical to successful engagement in everyday activities. Executive dysfunction can negatively impact a person’s ability to learn in different contexts and complete everyday activities. The Weekly Calendar Planning Activity (WCPA) is a new standardized assessment to measure EF in the context of a real-world task for adults. **Purpose:** Gain an understanding of the clinical utility of the WCPA-Student version (WCPA-S) in assessing EF. Examine the validity of the WCPA-S by exploring its relationship with other measures of EF and its ability to differentiate college students with and without learning differences. **Methods:** Participants included 160 graduates and undergraduates aged 18-30. Participants completed a demographics form, WCPA-S, Behaviour Rating Inventory of Executive Function, Zoo Map Test, and Dysexecutive Questionnaire. Correlational

analyses were performed to measure the concurrent validity. T-tests examined differences in student status, sex, and students with and without learning differences. **Results:** Results are currently pending analysis and will be presented on the poster at the research presentation. **Conclusion:** Participation is the ultimate goal in occupational therapy. The WCPA-S is a measure that may be used for college students who are struggling with organizing and planning their everyday activities. This study aims to provide support for the validity of the WCPA-S as a tool that can be used to provide information to help understand difficulties faced by college students through its occupation-focused assessment of students’ planning and organizational abilities.

Poster #139

Title: Oral health experiences of Latinos with children with & without disabilities

Authors: Daniella C. Floríndez, Elizabeth Pyatak, Dominique H. Como, Sharon A. Cermak, & Lourdes Baezconde Garbanati

Faculty advisor: Sharon A. Cermak

Background: Research on oral care has shown that Latinos are more likely to have misperceptions about oral health, and less likely to have access to dental care than the general population. To date, minimal research has explored the oral health experiences of Latinos. **Purpose:** This study examined oral health related attitudes, beliefs, and practices in Latino families with and without children with Autism Spectrum Disorder (ASD). **Methods:** As part of a larger qualitative study on in-home oral care, 18 Latino families with a child aged 6-12 (n=8 neurotypical, n=10 ASD) were interviewed twice for approximately 1-2.5 hours each session. Interviews were transcribed verbatim and analyzed by 3 coders using in vivo and thematic coding schemas to identify patterns throughout the

data. **Results:** The themes *Vulnerability/Mistrust*, “*We have to put our children first*,” and *Acculturation/Cultural Practices* summed how the Latino families discussed oral care. Parents described fear of the dentist as a key factor inhibiting receipt of dental care. Parents also discussed prioritizing the dental needs of their children over their own oral care needs due to costs. Families also shared cultural influences on oral care habits that were learned from their varied upbringing. **Conclusion:** Latinos’ experiences of oral health are influenced by factors related to their cultural identities, family structures, and barriers to oral care. Understanding the oral health beliefs and experiences of Latino parents is critical for developing targeted prevention programs to meet the needs of the population.

Poster #140

Title: Neuroendocrine model of occupational balance

Authors: Raymond Hernandez

Faculty advisor: Beth Pyatak

Purpose: To explain the concept of allostatic load and argue that its implications warrant consideration of a new model of occupational balance, the Neuroendocrine Model of Occupational Balance, which is not meant to replace but rather complement existing conceptions of lifestyle balance. **Background:** A general endocrinological conceptualization of stress is utilized here where it is defined as a state in which there is a perceived or actual threat to homeostasis, accompanied by a physiological stress response resulting in effects including an increase in arousal and vigilance (Chrousos, 2009). Stressors in this broader view include psychosocial stressors, physical movement, highly motivating tasks, and cognitive demands (Epel et al., 2018). Excessive amounts of this more general stress is believed in the neuroendocrinology literature to result in metabolic wear and tear, also known as allostatic load (AL). Higher

levels of AL have been associated with negative outcomes including several health issues (Seeman, 1997). **Methods:** A conception of occupational balance was proposed here utilizing the neuroendocrine concept of allostatic load as its basis. Literature from various fields including neuroendocrinology, integrative medicine, and psychology were drawn from. This model will be used as the basis for future empirical testing. **Results:** Occupational imbalance can in part be conceptualized as an excessive amount of time spent in an endocrinologically stressed state and/or an insufficient time in restful states, which could lead to AL accrual. **Conclusion:** A neuroendocrine model of occupational balance would help to advance our understanding of the conditions of lifestyle balance.

Poster #141

Title: Comparison of two automated motion correction strategies in autism neuroimaging

Authors: Aditya Jayashankar, Laura Harrison, Christiana Butera, Emily Kilroy, Jonas Kaplan, & Lisa Aziz-Zadeh

Faculty advisor: Lisa Aziz-Zadeh

Background: Motion artifacts have a significant effect on the interpretation of functional MRI (fMRI) data, especially in children with ASD, who tend to move more than controls during scanning (Pardoe, Hiess & Kuzniecky, 2016). Manual classification of artifacts is time consuming; automated classification is a desirable motion-correction strategy. **Purpose:** To implement and compare the automated performance of (1) ICA-AROMA (Pruim, 2015) and (2) FIX (Salim-Khorshidi, 2014; Carone, 2017). ICA-AROMA works off a predefined training set, while FIX can be trained on acquired data. **Methods:** Data of 58 subjects ages 8-15 (22 ASD), each performing two passive tasks, were preprocessed using FSL (Jenkinson, 2012). After ICA of all preprocessed data, motion correction was done with the unalterable

ICA-AROMA. Components of 47 participants were manually classified for signal and noise components (Griffanti et al, 2017) and compiled into a training data set using FIX. Trained automated identification of signal vs. noise components in the remaining data was then performed. **Results:** Qualitative analysis of the motion correction results showed higher accuracy in the detection of task-correlated motion and multi-band acquisition artifacts by FIX over ICA-AROMA. Cross-validation showed FIX maintained 94.2% detection accuracy. FIX significantly identified more signal in participants with minimal motion ($p=0.0215$), and more noise in those with high motion ($p=0.02$). **Conclusion:** Training FIX with manually classified data provides a more robust and flexible approach to filtering noisy signals in task-based fMRI data. While the hand classification is subjective, additional raters or blind sample rating could overcome the caveat of single-rater bias.

Poster #142

Title: Corticospinal tract lesions of various origins predict stroke motor outcome

Authors: Kaori L. Ito & Sook-Lei Liew

Faculty advisor: Sook-Lei Liew

Background: The amount of overlap between the corticospinal tract and a stroke lesion (CST lesion load, CST-LL) is one of the strongest known predictors of post-stroke motor outcomes. Most research on CST-LL has focused on projections originating from the primary motor cortex (M1), but other higher-order cortical motor areas also have projections that contribute to the CST. Damage to such areas may contribute to motor deficits following stroke. **Purpose:** We evaluate whether CST-LL from various motor origins predicts motor performance. **Methods:** We used ATLAS, a publicly available multi-site database, to obtain 170 anatomical MRIs, lesion

masks, and motor scores of individuals with chronic stroke. Lesion load was calculated as the percent overlap between the lesion mask and the following regions: M1, supplementary motor area (SMA), pre-supplementary motor area (preSMA), ventral and dorsal premotor cortex (PMv & PMd), and primary somatosensory cortex (S1). Backward stepwise elimination was used to determine the best predictor of motor scores among all ROIs, starting with a full linear mixed effects model with each ROI, age, and sex as fixed effects, and site as a random effect. **Results:** The selected model retained the following fixed effects: SMA ($F=11.45$, $\beta=-1.52$, $p=0.00089$); PMv ($F=6.08$, $\beta=-0.29$, $p=0.015$); and PMd ($F=7.51$, $\beta=1.08$, $p=0.0068$). Model fit values are as follows: full model (AIC=-68.5; conditional $R^2=0.52$); selected model (AIC=-74.12; conditional $R^2=0.51$). **Conclusion:** This work suggests that lesion load of CST projections originating from specific higher-order motor regions beyond M1 may be

**OCCUPATIONAL
THERAPY &
OCCUPATIONAL
SCIENCE
POST-DOCTORAL
FELLOWS**

Poster #143

Title: Identifying an optimal sampling method to estimate postural risk

Authors: Kryztopher D. Tung, Nancy A. Baker, Yoko E. Fukumura, Jane L. Forrest, & Shawn C. Roll

Faculty advisor: Shawn C. Roll

Background: The Rapid Upper Limb Assessment (RULA) is an ergonomic assessment tool used to screen for risk of musculoskeletal injury due to

working posture. The RULA is traditionally applied once during a work task to approximate overall risk. No method exists for estimating a RULA score for work requiring frequent shifts in posture across time. **Purpose:** The goal of this study was to identify an optimal sampling method for applying the RULA across a long time-period that accurately represents overall risk. **Methods:** Four right-handed female dental hygiene students were video recorded from three angles while performing hand scaling during patient clinic visits (88.97 minutes on average). RULA was continuously scored across the entire session, updating the score when a significant postural shift lasting for more than 15 seconds occurred. A time-weighted average (TWA) RULA score was calculated. Three sampling methods were evaluated: equivalent interval samples, random samples, and random samples within clock positions. Each method was compared to the TWA using a paired samples t-test and percent difference. **Results:** TWA RULA across the four students ranged from 3.38 to 4.26. Preliminary sampling averages using 10 samples were all within 0.2 of the TWA. Further iterations evaluating various sample sizes is ongoing. **Conclusion:** Preliminary results indicate that a valid sampling method would be a viable substitute for the TWA RULA. Development of a robust dataset demonstrating variability across sampling methods and sizes will help to identify the most efficient method that can be applied to a variety of work settings.

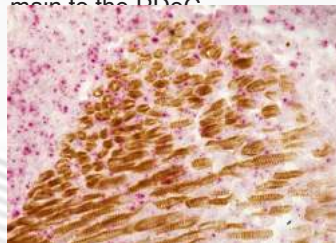
Poster #144

Title: Sensorimotor domain improves original RDoC classification of ASD from DCD

Authors: Laura Harrison, Anastasiya Kats, Christiana Butera, Emily Kilroy, Aditya Jayashankar, Priscilla Ring, Ryann MacMurdo, & Lisa Aziz-Zadeh

Faculty advisor: Lisa Aziz-Zadeh

Background: The NIH's Research Domain Criteria (RDoC) aims to describe biological and psychological functioning in mental health across six domains: negative and positive valence systems, cognitive systems, social processes, arousal and regulatory systems, and, recently, sensorimotor systems. **Purpose:** To test the improved ability of the RDoC in distinguishing children with autism spectrum disorder (ASD)—who have both sensorimotor and social deficits—against children with primarily motor deficits (developmental coordination disorder, DCD) and typically developing (TD) controls, we used machine learning to classify each of these three groups according to psychological measures that map onto the original RDoC domains and onto sensorimotor functioning. **Methods:** Behavioral data were separately collected from 68 children aged 8-17 (24 TD, 28 ASD, 16 DCD). Measures were mapped onto motor, sensory, and original RDoC domains. Multiclass support vector machine classifiers were created for each of these domains separately as well as combinations thereof. Performance during a repeated stratified k-fold cross validation of the different classifiers for predicting group membership (one versus rest, e.g., ASD versus DCD and TD) was compared. **Results & Conclusion:** Alone, the original RDoC category performed best overall, with accuracy ranging from 86% (DCD) to 90% (TD). However, the sensory and motor classifiers alone still performed above chance, with accuracy ranging from 70% (ASD motor) to 90% (TD motor). Performance was best when all three domains were combined, with accuracy at 88% for ASD and DCD and 97% for TDs, supporting the addition of a sensorimotor domain to the RDoC.



OCCUPATIONAL THERAPY & OCCUPATIONAL SCIENCE PROFESSIONAL STUDENTS

Poster #145

Title: Supporting development in young children experiencing homelessness: a literature review

Authors: Emily Campi, Amy Zhao, & Grace Baranek

Faculty advisor: Grace Baranek

Background: The prevalence of children (0-18) experiencing homelessness in the U.S. numbers 2.5 million for ≥ 1 night per year. 20,964 people experience homelessness with their families on any night in California. 51% of children in shelters and transitional facilities are < 6 years old. These children are at high risk for poor developmental outcomes. **Purpose:** To review literature on homelessness-related risks to development and explore barriers to participation in developmental services. **Methods:** A literature review using PubMed and Google Scholar included search terms such as: homelessness and infancy, children, and/or trauma. Studies with participants over age 18 or children experiencing homelessness without caregivers were excluded. **Results:** Children experiencing homelessness have high rates of stressful life events (average=3.05), trauma symptoms (average=1.05), and emotion/behavior problems (28% above clinical cut-off; 18%=normative expected rate). Developmental risk for children experiencing homelessness begins prenatally; homeless mothers are more likely to give birth to low birth weight or preterm babies, who are at higher risk for neurodevelopmental disorders.

Additionally, children in lower socioeconomic status (SES) brackets have later age of diagnosis for autism as compared to higher SES peers, indicating a lack of access to and knowledge about developmental services. Finally, these children are deprived of play opportunities that support development and family bonding. **Conclusion:** Infants and toddlers experiencing homelessness are an underserved population with unique needs that must be considered when developing screening, diagnostic, and intervention practices. This literature review lays the empirical foundation for a needs assessment related to development in homeless youth.

FROM THE EDITORS

STUDENT RESEARCH GROUP || SRG

To our fellow students, faculty, and staff

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

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

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. Our Student Research Group thrives on the encouragement and support we have received from our faculty advisors.

Thank you, and Fight On!
Ruhee Jaffer & Yeonghee Jung

2018-2019



"Through the PDS® PRIVATE PRACTICE +® platform, I was able to achieve my dream of owning my own dental practice sooner than I ever could have imagined. The support from PDS makes it possible for me to focus on clinical excellence and helps me enjoy a balanced lifestyle."

BIANCA VELAYO, DMD
PDS-supported Practice Owner



Dentist

Freedom to care. Support to **succeed.**

A solid platform to see your
career thrive.



PACIFIC
DENTAL SERVICES®

TO LEARN MORE,
EMAIL: Info@pacden.com
OR VISIT: PacificDentalServices.com

THE EXPLORER JOURNAL OF **USC** STUDENT RESEARCH VOLUME 11

Presidents / Editors in Chief
Ruhee Jaffer
Yeonghee Jung

Faculty Advisors
Yang Chai, DDS, PhD
Parish Sedghizadeh, DDS, MS

Senior Editor
Bridget Samuels, PhD

Vice President
Azzah Widadalla

**Student Research Involvement
Director**
Sara Kahng

Secretary
Teresa Nguyen

Photography Editors
Henry Yim
Jiawei Li

RESEARCH
DAY
2019

RESEARCH DAY
PLANNING
COMMITTEE

Yang Chai, DDS, PhD
Parish Sedghizadeh, DDS, MS
Donna Castillo
Jaime Gonzalez
Patty Gutierrez
Linda Hattemer
Thach-Vu Ho
Lynn Matsumoto
Barbara Roddy
Raquel Saez
Bridget Samuels, PhD
Oshawa Smith

APRIL 10, 2019

All views are of the authors and do not necessarily represent those of the student body of the Herman Ostrow School of Dentistry of USC nor of the editors of the Explorer Journal, unless such statements have been officially adopted by the University. The Explorer Journal editorial board reserves the right to reduce, revise or reject any material submitted for publication. Articles and photos published in the Explorer Journal are the property of the Explorer Journal and may be reproduced or reprinted only after written permission has been granted. The editors and founder reserve the right to accept, reject, discontinue or edit any article, letter, or abstract submitted for publication.

