Modern Human Anatomy Program

UNIVERSITY OF COLORADO
ANSCHUTZ MEDICAL CAMPUS

2022

Capstone Project Presentations

Tuesday, April 19th

2022 Modern Human Anatomy Program
Capstone Poster Presentations

April 19, 2022

Education 2 Bridge
University of Colorado Anschutz Medical Campus

12:00 PM – 1:00 PM	Lunch
1:00 PM – 2:30 PM	Presentation for Session I posters
2:30 PM – 4:00 PM	Presentations for Session II posters

Session I Poster Presenters
1:00 PM – 2:30 PM

Capstone Poster Presenter	Poster #	Abstract Page #	Poster Title	Category
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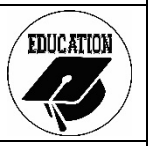
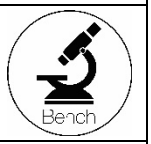
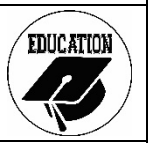
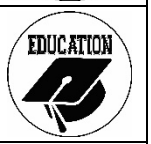
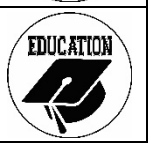
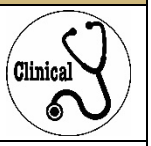
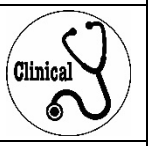
Monica Fong	**2**	6	Glenohumeral Ligaments Explained: The Use of a 3D Printed Model to Understand the Movement of the Glenohumeral Joint	
Denisa Grofova	**3**	7	Phosphorylation of T214 SNPH Does Not Alter Mitochondrial Subcellular Distribution in Cancer Cells	
Katherine Gustilo	**4**	8	A Novel En Bloc Circulatory System Dissection: A Teaching Tool for Systems-Based Medical School Curricula	
Robyn Pierce	**5**	9	The Creation of a Cost-Effective, Reusable, and Accurate Ultrasound Phantom of the Interscalene Space and Brachial Plexus	
Logan Scott	**6**	10	Tele-Ultrasound: Virtual Hands-on Medical Education for Novice Users Utilizing FAST & Carpal Tunnel Models, Pilot Study	
Kyetiil Vicenti	**7**	11	Sick and Tired of Learning Psychiatry the Old Way? Try Hippocampus Game	

Session II Poster Presenters
2:30 PM – 4:00 PM

Capstone Poster Presenter	Poster #	Abstract Page #	Poster Title	Category
Jane Brusilovsky	**8**	12	Conversational Floor Exchanges in Neurodegenerative Disorders	
Jessica Hoffman	**9**	13	In-Utero Maternal Depression Exposure and the Offspring Amygdala	
Linda Neely	**10**	14	Post-concussion exercise frequency is associated with a decreased risk of developing persistent post-concussion symptoms	
Benjamin Rajic	**11**	15	Brain-Body Connection: Synchronization of Endogenous Insulin and Hypothalamic Neuronal Activity During Hyperglycemia	
Amanda Telfer	**12**	16	An Evaluation of 3D Printed Cardiac Models and Their Role in Patient, Caretaker, and Staff Education: One Print, Multiple Uses	
Jeannie Than	**13**	17	Step Into Another World: Virtual Reality Applications in the Cardiac Catheterization Laboratory for Patients with Congenital Heart Disease	
Ryan Wendell	**14**	18	The Role of Pain in Gait Deviations Caused by Unilateral Hip Osteoarthritis	

Thank you to faculty serving on capstone committees, as these projects would not be possible without your commitment to the success of our students.

MSMHA Student	Capstone Committee Chair	Capstone Mentor	Committee Member	Committee Member
Jane Brusilovsky	Ernesto Salcedo, PhD	Peter Pressman, MD	Elliott Ross, MD	
Jamie Ernewein	Danielle Royer, PhD	Caley Orr, PhD	Anna Warrener, PhD	
Monica Fong	Caley Orr, PhD	David James, DPT	Noah Leppek	
Denisa Grofova	John Caldwell, PhD	Cecilia Caino, PhD	Ernesto Salcedo, PhD	
Katherine Gustilo	Maureen Stabio, PhD	Chelsea Lohman Bonfiglio, PhD	Chelsea Goldberg, MS	Shannon Curran, MS
Jessica Hoffman	John Thompson, PhD	Allison Shapiro, PhD	John Caldwell, PhD	
Linda Neely	Maureen Stabio, PhD	David Howell, PhD	Katherine Smulligan, DPT	
Robyn Pierce	Chelsea Lohman Bonfiglio, PhD	Matthew Riscinti, MD	Danielle Royer, PhD	
Benjamin Rajic	Ernesto Salcedo, PhD	Allison Shapiro, PhD	Kristin Nadeau, MD	
Logan Scott	Danielle Royer, PhD	Juliana Wilson, DO	Chelsea Lohman Bonfiglio, PhD	
Amanda Telfer	Danielle Royer, PhD	Jenny Zablah, MD	Michael Shorofsky, MD	
Jeannie Than	Ernesto Salcedo, PhD	Jenny Zablah, MD	Gareth Morgan, MD	
Kyetiil Vicenti	Maureen Stabio, PhD	Abraham Nussbaum, MD	Norma Wagoner, PhD	
Ryan Wendell	Ernesto Salcedo, PhD	Cory Christensen, PT, PhD	Hope Davis-Wilson, PhD	

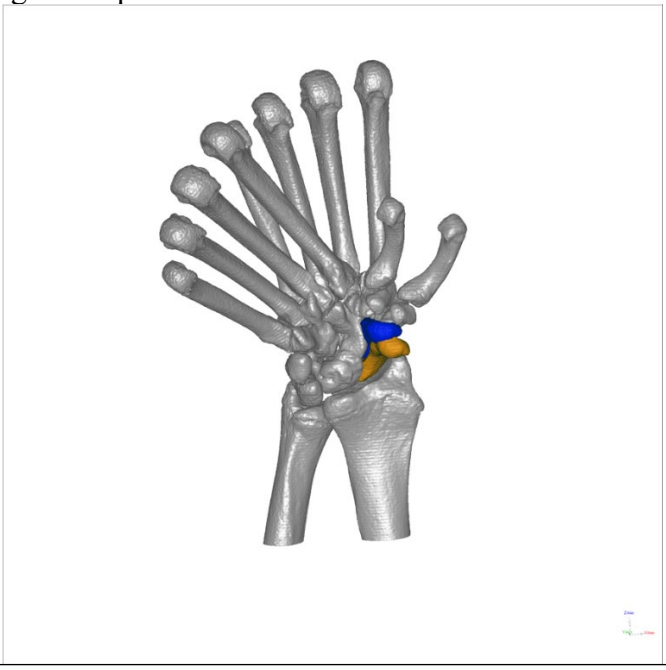
Session I: 1:00 PM – 2:30 PM

Poster #1 Jamie Ernewein

Bullseye! Preliminary Results on the Kinematics of the Dart Thrower Motion in Non-Human Primates

Capstone Committee: Danielle Royer (chair), Caley Orr (mentor), Anna Warrener

ABSTRACT:
Little research has been done on the kinematics of the wrist following the dart thrower's pathway in nonhuman primates. The dart thrower motion in Homo sapiens (humans) is defined as a combination of radial deviation and extension moving into ulnar deviation and flexion facilitated by a "path of least resistance" for the movement of the carpals. This pathway is involved in precision and power grips and has been hypothesized to be a unique adaptation to human tool behavior. However, this plane of motion has not been described in primates despite the wrist's anatomic similarities. Using a 3D computed-tomography based method for markerless bone registration and kinematic analysis of anthropoid primate cadavers we tracked scaphoid motion to test the hypothesis that nonhuman primates maintain a stable proximal row across the dart thrower plane of motion. Preliminary results suggest that in nonhuman primates the scaphoid has somewhat limited rotation along dart thrower's plane of motion approximating the results for humans. There is some indication that apes may have greater scaphoid rotation along the dart thrower path than humans and monkeys, but this requires further analysis. Future research will focus on the analysis of the lunate and triquetral rotations to complete our understanding of the proximal row kinematics.



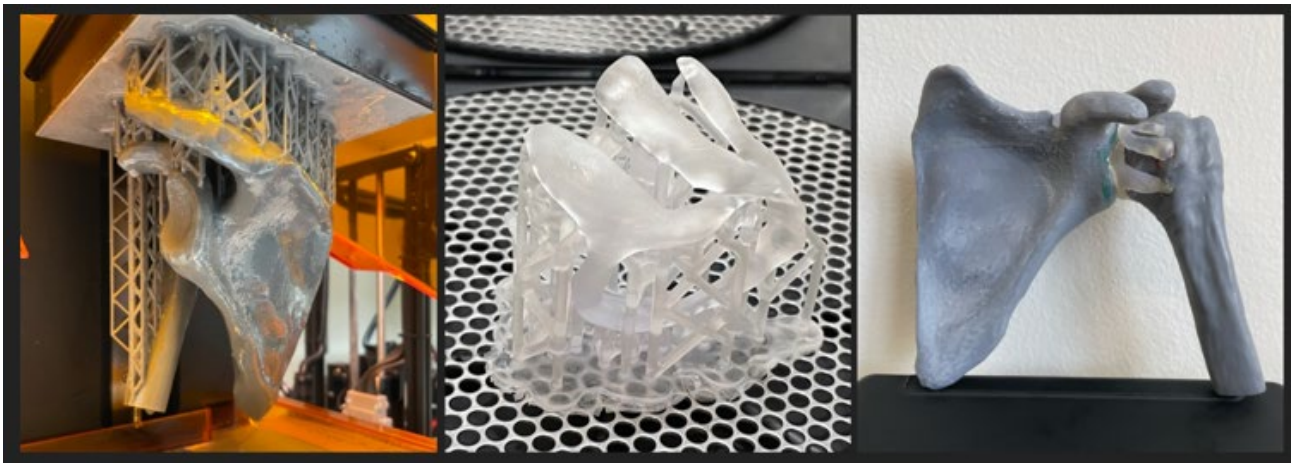
3D model of *Pan troglodytes* (Chimpanzee) wrist going from a neutral position to ulnar deviation. The scaphoid highlighted in orange is in a neutral position and the blue scaphoid has moved into ulnar deviation.

Poster #2 Monica Fong

Glenohumeral Ligaments Explained: The Use of a 3D Printed Model to Understand the Movement of the Glenohumeral Joint

Capstone Committee: Caley Orr (chair), David James (mentor), Noah Leppek

ABSTRACT:
Three-dimensional (3D) models are a valuable visual and kinesthetic educational tool to understand spatial anatomical relationships. Understanding the movement of joints requires students to have not only a strong foundation of anatomy, but also complementary skills to visualize the movement in 3D. The current methods for teaching these concepts include 2D images, video animations, cadaver dissections, and others. Evaluating various methods showing joint movement has not been well documented in literature. In addition, a 3D model of the shoulder joint has yet to be created for movement purposes. This study created and evaluated the effectiveness of a 3D printed model of the glenohumeral joint and its respective glenohumeral ligaments. It was hypothesized that a physical model would be more effective for students to understand the structure and function of the glenohumeral ligaments compared with students using 2D images for reference. Furthermore, the use of a 3D model would be more enjoyable to use and increase student interest and confidence levels in the subject more than using textbooks as a resource. First-year physical therapy students were randomly assigned to use either textbooks or a 3D model to study the shoulder anatomy after learning about the subject with a pre-recorded PowerPoint lecture module. Learning outcomes were assessed with pre- and post-quizzes. Overall data showed that there was no significant difference in the learning outcomes between the Model and Textbook groups. Confidence and interest levels were evaluated with pre- and post-surveys. For the Model group, confidence in their ability to identify ligaments and visualize anatomical structures in 3D increased after using the 3D model but not in the Textbook group. This study suggests that physical therapy students find 3D models more helpful and enjoyable to learn from than only having 2D images to reference.



3D Printed Model of the Glenohumeral Joint

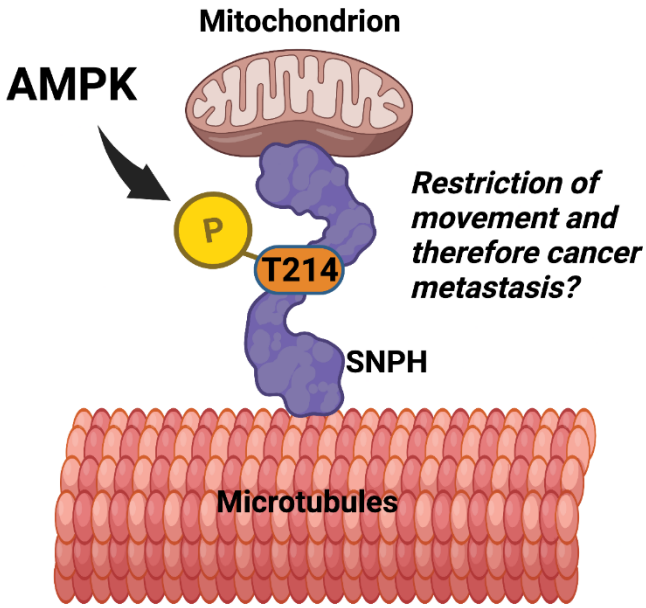
Poster #3 Denisa Grofova

Phosphorylation of T214 SNPH Does Not Alter Mitochondrial Subcellular Distribution in Cancer Cells

Capstone Committee: John Caldwell (chair), Cecilia Caino (mentor), Ernesto Salcedo

ABSTRACT:
Despite remarkable progress identifying the molecular and biochemical determinants of the metastatic process, we still lack actionable targets within the metastatic cascade. In this context, my project focuses on studying the subcellular localization of mitochondria in metastatic cells.

Mitochondria have a multifaceted role in metastatic cancer and host many important signaling networks in cancer cells. In this context, Syntaphilin (SNPH), a known molecular brake on axonal mitochondria, is downregulated or lost in tumor progression, suggesting a role of SNPH in halting metastatic progression. Lower SNPH expression correlates with shortened patient survival, increased mitochondrial trafficking to the cortical cytoskeleton, and increased cell invasion. When SNPH is expressed in tumors, it inhibits the speed and distance travelled by individual mitochondria and blocks chemotaxis and metastasis, in vivo. SNPH can be regulated by post-translational modification at several of its residues. Previous studies showed that ubiquitination of SNPH resulted in enhanced anchoring of mitochondria to microtubule cytoskeleton. Here, I investigate the phosphorylation at T214 of SNPH and its effect on the localization and morphology of mitochondria in metastatic cancer cell lines. My results show that SNPH is phosphorylated at T214 by a known cellular energy sensor, 5'AMP-activated protein kinase (AMPK). A non phosphorylatable T214A-SNPH mutant did not alter mitochondrial subcellular localization, suggesting that phosphorylation of SNPH at T214 plays a role in SNPH-dependent cell metabolism. This opens a new area for the investigation of potential therapeutic targets for metastatic cancer.

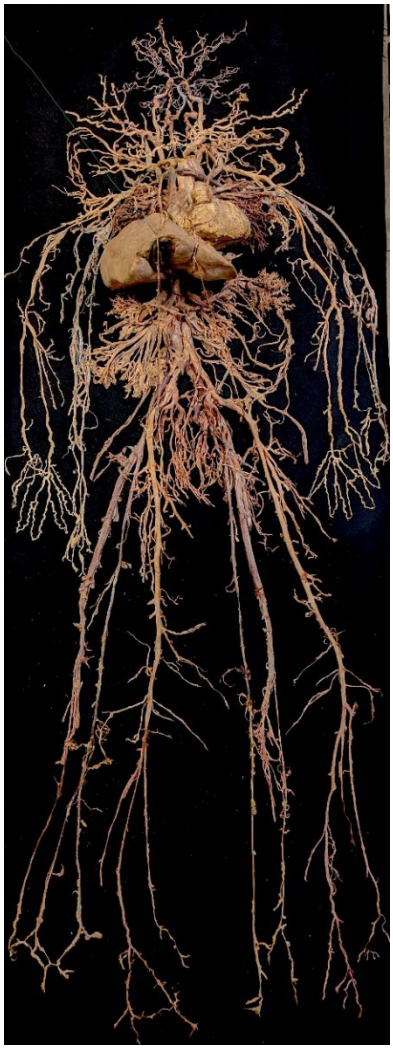


Poster #4 Katherine Gustilo

A Novel En Bloc Circulatory System Dissection: A Teaching Tool for Systems-Based Medical School Curricula

Capstone Committee: Maureen Stabio (chair), Chelsea Lohman Bonfiglio (mentor), Chelsea Goldberg, Shannon Curran

ABSTRACT:
With the transition to integrative, systems-based anatomical instruction in medical school curricula, the use of traditional, region-based, cadaveric dissection has decreased while the use of systems-based prosections has increased. Recent studies have demonstrated the value of such prosections for the nervous system through an en bloc extraction of the central nervous system. However, comparable approaches for the circulatory system have not been reported, and there are currently no dissection instructions for an en bloc circulatory system extraction that do not require polymer injection into vessels prior to embalming. Thus, the goal of this project was to prosect, extract, and preserve the circulatory system en bloc for long-term use in a systems-based integrated medical curriculum. One male cadaveric donor without documented vascular disease or pathology was used to extract the following structures in a single interconnected piece: the heart, more than 350 named arteries, 10 superficial veins, 21 veins of the portal system, the liver, and at least 27 major veins of the caval system. Vascular structures were carefully isolated from the surrounding tissues in each region of the body over the course of approximately 250 hours by a single dissector. Muscles, nerves and organ tissues were cleared from the vessels using common dissection tools, including scissors, forceps, probes, and scalpels. Extraction of vessels from bones required use of chisels, rib cutters, and an autopsy electric saw. Best approaches, challenges, and time-saving strategies were recorded. The circulatory system was successfully extracted from the limbs, torso and head in a single piece after embalming without the need for advanced polymer injection. A detailed dissection guide with instructions and images was developed, so this dissection could be replicated. The cadaveric specimen will be plastinated in approximate anatomical position with small tags placed on all named vessels to allow for easy identification of each structure and long-term use. This prosection is a novel approach to meet the needs of changing medical school curricula by illustrating the complexity and continuity of the circulatory system as a whole system. The 3D display will allow students to access a real, anatomical model that comprehensively demonstrates the majority of named vessels, providing the necessary context to augment 2D images, vascular diagrams, and atlases. Subsequent investigations will evaluate the educational value of this model in a flipped-classroom approach. Future plans also include surface scanning and 3D-printing the model to reproduce a less time-consuming replica. This reimagination of traditional dissection techniques has generated new avenues for illustrating the human body, even in an established field such as gross anatomy.



Poster #5 Robyn Pierce

The Creation of a Cost-Effective, Reusable, and Accurate Ultrasound Phantom of the Interscalene Space and Brachial Plexus

Capstone Committee: Chelsea Lohman Bonfiglio (chair), Matthew Riscinti (mentor), Danielle Royer

ABSTRACT:
Ultrasound phantoms are manufactured model simulations of living patients that can be used to train inexperienced individuals in performing a wide variety of procedures. Practice of procedures on nonliving materials is essential to the training process, to maintain a level of patient comfort and physician accuracy. Ultrasound phantoms can be handmade or procured commercially. Homemade phantoms often lack enough detail to portray realistic tissues, while commercial models are cost prohibitive creating a financial burden that many institutions may not be able to afford. In this study, we aim to create a cost-effective and anatomically accurate homemade phantom of the interscalene space that can be used for repeated interscalene nerve block practice. Anatomical structures obtained from a live patient CT scan were used to 3D print and shape a novel model. The goal is to create a phantom composed of inexpensive and readily available materials that is anatomically accurate and resembles the tissue of a living patient under ultrasound imaging. The resulting model will ultimately be used to examine whether it is a feasibly realistic model for procedural practice; however, in this proof of concept project, we aim to examine best practices for producing a realistic, and affordable, handmade ultrasound phantom.

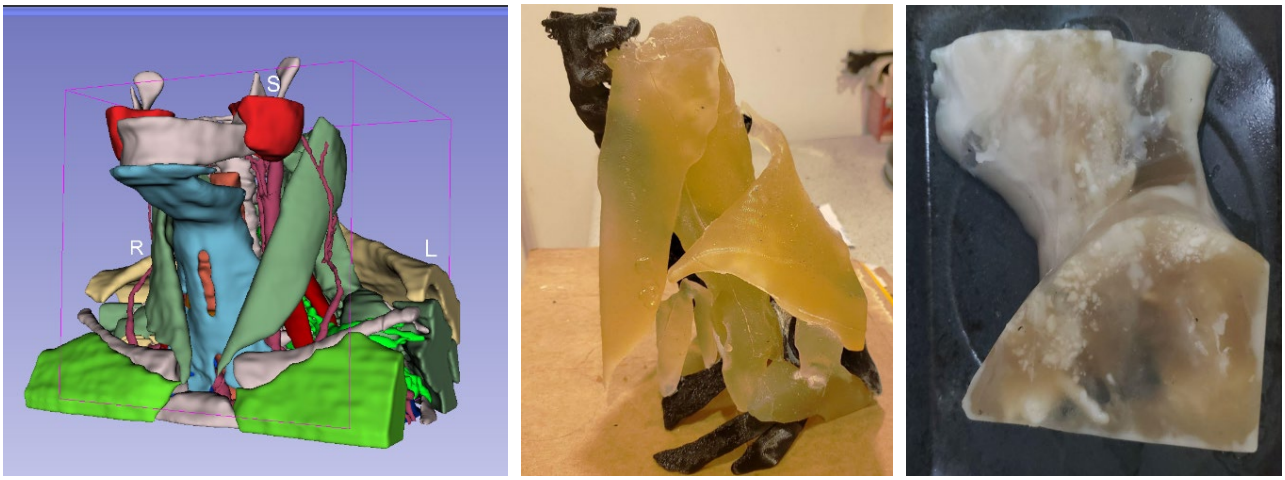


Figure 1: Creation of an ultrasound phantom of the interscalene space. The 3D model created from patient CT scan (A), assembly of the ballistics gelatin muscular structures (B), and the completed phantom (C).

Poster #6 Logan Scott

Tele-Ultrasound: Virtual Hands-on Medical Education for Novice Users Utilizing FAST & Carpal Tunnel Models, Pilot Study

Capstone Committee: Danielle Royer (chair), Juliana Wilson (mentor), Chelsea Lohman Bonfiglio

ABSTRACT:

Introduction

Ultrasound (US) training is an emerging tool that is being utilized to enhance anatomy education in medical schools with preliminary incorporation into non-medical anatomy courses. The need for distanced, virtual, education has always been present in rural areas, yet it has increased exponentially across all populations due to COVID-19. Recent developments in point-of-care-ultrasound (POCUS) have enabled relay of remote imaging and communication, Tele-US. This pilot study aims to assess whether the integration of virtual self-paced modules and virtually guided ultrasound sessions, utilizing the Butterfly iQ (BiQ) US device, is as effective as in-person (IP) learning for novice users.

Materials & Methods

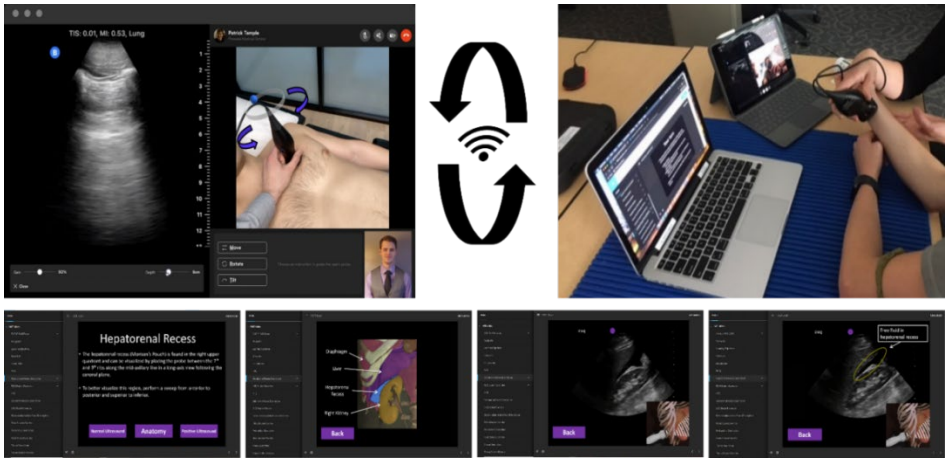
Study sessions consisted of three modules, each 30 minutes in duration: Introduction, Carpal Tunnel (CPL-T), Focused assessment with sonography in trauma (FAST). Live hands-on active learning sessions utilized CPL-T and FAST modules where groups of 2-3 participants performed peer-peer scanning. Hands-on guidance was given to IP groups, whereas virtual groups received guidance through the BiQ Tele-guidance software (TGS). The TGS provides remote video conferencing, real-time imaging relay for simultaneous viewing by the operator and educator, educators ability to remotely change settings, and the integration of augmented reality to provide visual cues to the operator on screen. 7 first-year Medical and 19 Modern Human Anatomy students (N=26) were invited to participate in the COIRB-exempt (#21-3964) pilot study. Pre- and Post-study online surveys were used to collect data on previous US training utilizing multiple choice questions and self-perception of confidence levels US skill and usefulness of the BiQ US system. Perceptions were assessed utilizing a 5-point Likert scale (1= strongly disagree/not useful/extremely difficult, 5= strongly agree/extremely useful/extremely easy). Additionally, a 17-point assessment was administered IP by staff on 4 key anatomical regions; median nerve, radial artery, hepatorenal recess, and thorax to assess participant US skill levels at the end of the live session. Order of assessment was randomly determined. Feedback was only provided to participants after the assessment period was completed for all participants.

Results

Two-way t-tests were used to assess post-study ratings and assessment scores. Pre- and post-study survey response rates were 96% (13 IP, 12 virtual) with roughly equal gender distribution. Comparison of post assessment survey did not show a significant difference in self confidence levels ($P>0.05$) between the IP and virtual groups across all 5 prompts: ease of CPL-T/ FAST, usefulness of BiQ, confidence in displaying CPL-T/FAST. Further, no significant difference in scores during the live session assessment were observed (IP average= 10.00 ±3.49, virtual average= 10.60 ±2.66; $P=0.62$). Detailed analysis was not performed due to the limited sample size of the pilot study. Future studies will assess additional in-group variances.

Conclusion

The results of this, small sample size, pilot study suggest that novice graduate level anatomy/medical students can demonstrate equivalent levels of competency, and perceived confidence when undergoing distanced US education using the BiQ Tele-US system when compared to IP courses. Further testing is required to expand the sample size and test in-group variances.

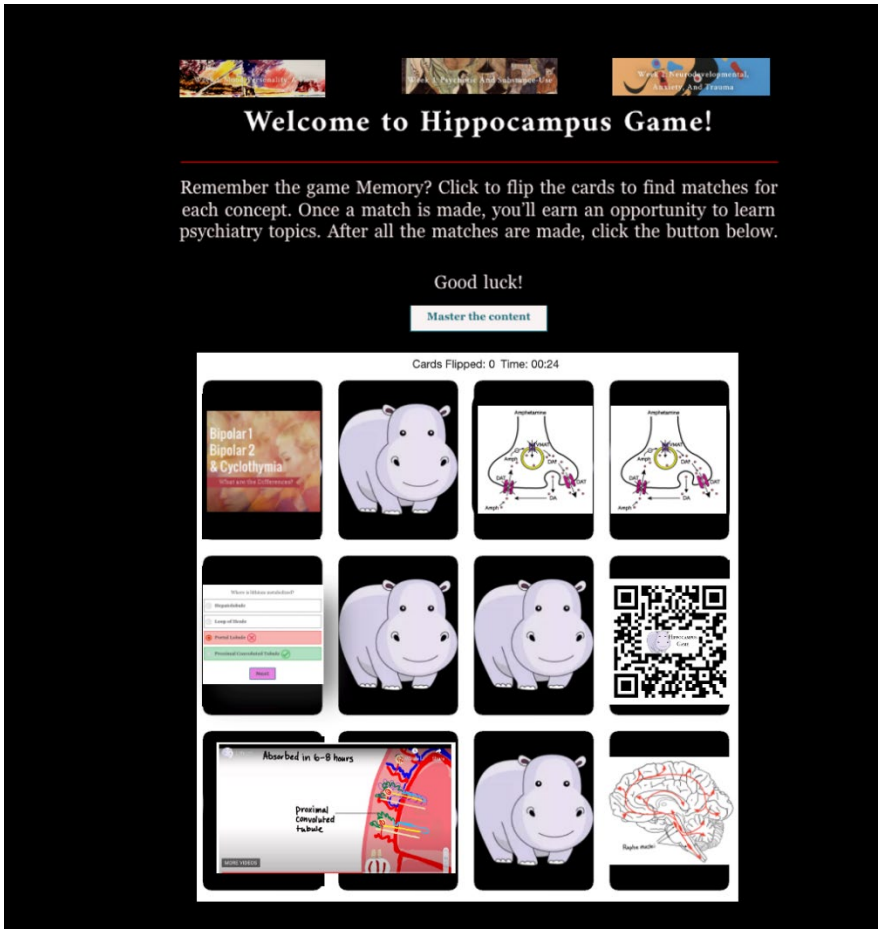


Poster #7 Kyetiil Vicenti

Sick and Tired of Learning Psychiatry the Old Way? Try Hippocampus Game

Capstone Committee: Maureen Stabio (chair), Abraham Nussbaum (mentor), Norma Wagoner

ABSTRACT:
Hippocampus Game is the first of its kind, offering an all-inclusive active learning game that chunks psychiatry topics according to similar concepts, showing engaging videos that present information in digestible amounts and enforce learning with post-quizzes. The objective of the capstone project is to build the Hippocampus Game (HG) and study if it produces the outcomes of gamification, including user engagement, fun, motivation to complete the game, and learning retention. Gamification in medical education is relatively new, especially in psychiatry, which HG will fill in the gap. HG was developed after the University of Colorado School of Medicine reformed its curriculum to include psychiatry in the first year of medical school, aiming to develop classes implementing a flipped-classroom approach. HG serves as the pre-work for the psychiatry course to introduce concepts taught during each lecture to delve deeper into the topic when they attend class. While playing HG, the students learn basic psychiatry topics through multimedia videos presented during gameplay and receive immediate feedback on missed concepts during post-quizzes. Three weeks of content were delivered and featured spaced repetition to enforce learning retention. The hypothesis is that integrating technology in the form of gaming and videos will increase student engagement. Surveys collected from a pilot group testing HG showed that the game was fun, the videos were engaging, and the immediate feedback was helpful. The limitations of this study were that the intended group for this project did not start the class, which could be an audience for future studies.



Session II: 2:30 PM – 4:00 PM

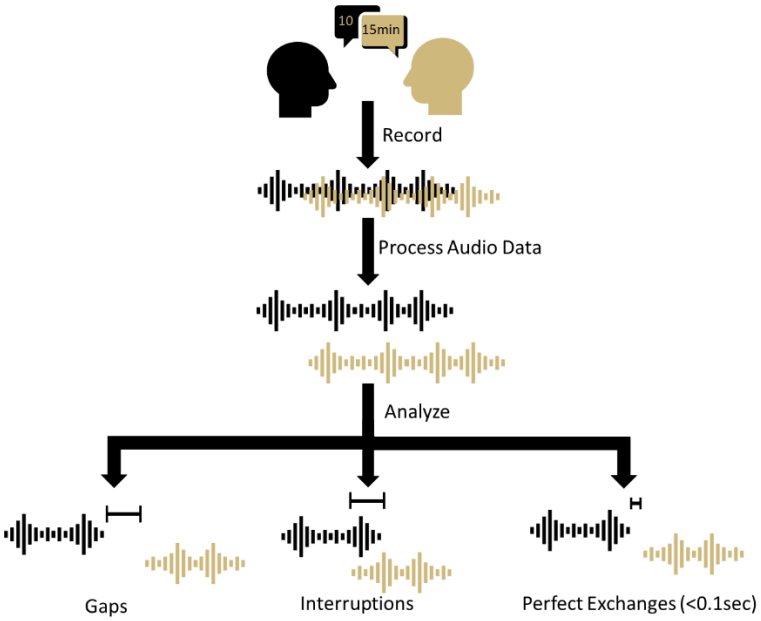
Poster #8 Jane Brusilovsky

Clinical

Conversational Floor Exchanges in Neurodegenerative Disorders

Capstone Committee: Ernesto Salcedo (chair), Peter Pressman (mentor), Elliott Ross

ABSTRACT:
Conversations construct a crucial aspect of daily life that can be analyzed to reveal a wealth of information. In particular, smooth transitions between speaking turns from one person to the next is an expected part of many conversations and these speaker transitions require a significant amount of coordination in the mind. Turn-taking combines high temporal coordination between participants with the remarkable complexity and open-endedness of the language and paralanguage that fills the turns. This project hopes to study turn-taking in conversations as a naturally occurring marker of various neurodegenerative disorders. The study will identify key markers in turn-taking that differentiate various disorders and healthy controls. Couples consisting of a healthy control and a person with a neurodegenerative condition were instructed to discuss a mutually selected topic of continuing disagreement in their relationship. Manual labeling of speakers, non-speech vocalizations and background noise was then performed using Praat. Statistical analysis was then performed on numerous conversational metrics, including both count and duration of gaps, interruptions, and pauses throughout the conversations. Compared to healthy controls, the various disorders had statistically relevant differences in gaps, interruptions, and perfect exchanges. Next steps include correlating data with imaging and neuropsychiatric testing as well as training machine learning models on this data.



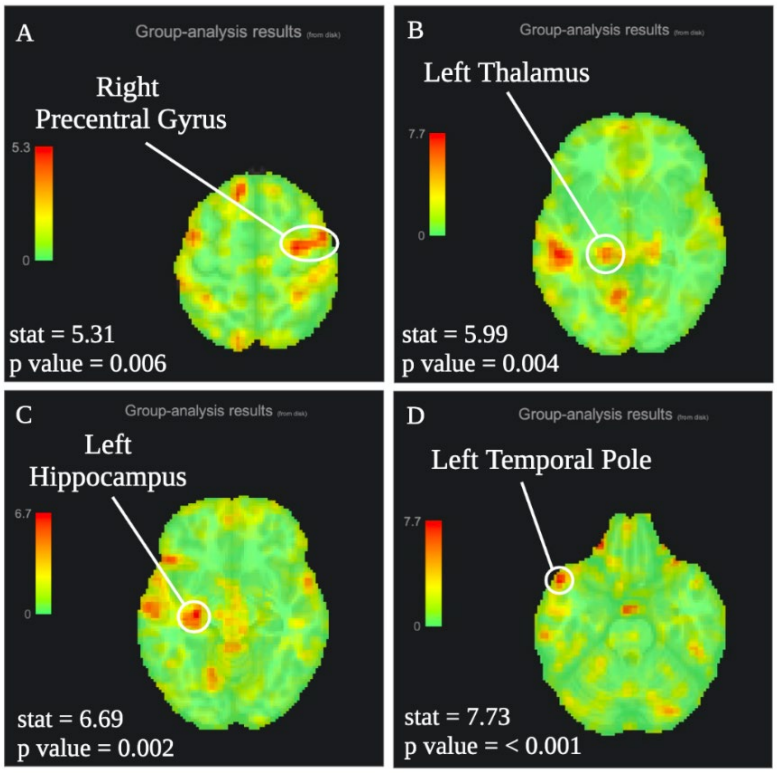
Poster #9 Jessica Hoffman

Clinical

In-Utero Maternal Depression Exposure and the Offspring Amygdala

Capstone Committee: John Thompson (chair), Allison Shapiro (mentor), John Caldwell

ABSTRACT:
In-utero maternal depression negatively affects offspring neurodevelopment by increasing the risk of problems with mental health (Stein et al., 2014), executive functioning (El Marroun et al., 2017), and behavior and emotional regulation (El Marroun et al., 2014). Alterations in offspring brain structure include cortical thinning of the prefrontal cortex (Sandman, et al., 2015), and the superior frontal cortex (El Marroun et al., 2016). However, the effects of in-utero maternal depression on the functional connectivity of the amygdala remains poorly understood, especially in children of this age. The objective of this project was to test the hypothesis that prenatal maternal depression is associated with increased activity of the offspring amygdala in 4–6-year-old children. Data were obtained from 101 mother-child dyads from the Health Start II study at the University of Colorado Hospital. Edinburgh Postnatal Depression Scale questionnaires were given to mothers at approximately 18- and 27-weeks gestation. Resting state functional MR imaging (RS-fMRI) was used to determine the functional connectivity between the amygdala and the rest of the brain in offspring. RS-fMRI scans were conducted on the children at a follow up visit between ages 4 to 6 years. The protocol was approved by the Colorado Multiple Institution Review Board, and written informed consent was provided by the mother or legal guardian of the child participant. We ran seed-to-voxel whole brain analyses to test the correlation between maternal depression scores and the connectivity of the amygdala to the rest of the brain. The results show a statistically significant ($p < 0.01$) univariate correlation between maternal depression and the connectivity of the amygdala with 16 regions of the brain. After controlling for additional covariates, the connectivity between the amygdala and these brain regions no longer reach significance. While our initial results support previous studies showing an increased functional connectivity in the amygdala, our corrected results contradict our hypothesis; therefore, results should be interpreted conservatively. Additionally, future studies should be done to include how the offspring amygdala is affected by postnatal factors.



Poster #10 Linda Neely

Post-concussion exercise frequency is associated with a decreased risk of developing persistent post-concussion symptoms

Capstone Committee: Maureen Stabio (chair), David Howell (mentor), Katherine Smulligan

ABSTRACT:
Introduction: Adolescents may experience persistent post-concussion symptoms (PPCS), or symptoms that do not resolve within 28 days of injury. Reduced physical activity and poor sleep health after concussion have each been independently associated with increased risk of developing PPCS. The purpose of our study was to determine whether sleep behavior (e.g., duration, timing) and/or physical activity (steps/day, or exercise frequency, duration, intensity) in the first month after concussion were associated with developing PPCS among a cohort of adolescents.

Methods: We prospectively enrolled adolescent athletes who sustained a concussion (N=49, age=14.8±1.8 years; 51% female) and were evaluated within 14 days of concussion (mean=6.7±2.7 days). Participants wore a commercial sleep and activity monitor to track sleep and physical activity behavior for two weeks after initial assessment. Participants were followed until symptom resolution, and the main outcome interest was development of PPCS (symptom duration >28 days). We then used a multivariable logistic regression model to examine associations between physical activity and sleep behavior with PPCS.

Results: Of the 49 patients included, 47% (n=23, symptom resolution=57±23 days post-injury) developed PPCS and 53% (n=26, symptom resolution=15±7 days post-injury) did not. The PPCS group took fewer steps/day (7526±2975 vs. 9803±3786 steps/day; p=0.02), exercised less frequently (2.5±2.2 vs. 4.4±2.1 days/week; p=0.005), and spent more time in bed awake (1.2±0.3 vs. 0.8±0.3 hours/night; p=0.03) than the no PPCS group. Multivariable results indicated the odds of developing PPCS significantly decreased with more exercise session/week (adjusted odds ratio=0.616, 95% confidence interval=0.389, 0.974, p=0.038).

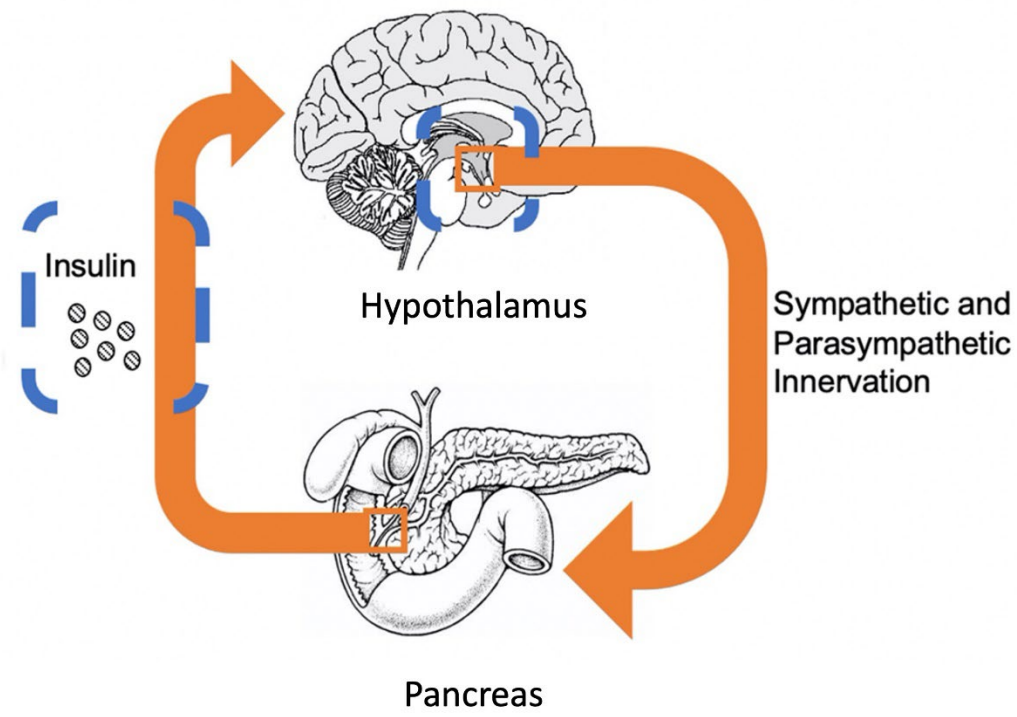
Conclusions: More exercise sessions per week during concussion recovery was associated with a lower risk of developing PPCS, while sleep and other physical activity measures were not. Further studies regarding exercise duration and intensity are needed, clinicians may consider advising patients to optimize sleep and physical activity during concussion recovery.

Poster #11 Benjamin Rajic

Brain-Body Connection: Synchronization of Endogenous Insulin and Hypothalamic Neuronal Activity During Hyperglycemia

Capstone Committee: Ernesto Salcedo (chair), Allison Shapiro (mentor), Kristin Nadeau

ABSTRACT:
Obesity and diabetes are characterized by dysglycemia, or dysregulated blood sugar. Dysglycemia is due to pancreatic insulin insufficiency and insulin resistance. The hypothalamus responds to insulin and modulates downstream pancreatic insulin secretion, and this feedback loop is known as the pancreatic-hypothalamic axis. Thus, the loss of hypothalamic insulin sensitivity may disrupt the axis and exacerbate dysglycemic conditions in already vulnerable patient populations. The objective of this study is to combine a hyperglycemic clamp technique with functional magnetic resonance imaging (fMRI) as a new in vivo model to study the pancreatic-hypothalamic axis in humans. Upon establishing an in vivo model for the pancreatic-hypothalamic axis using a hyperglycemic clamp to induce endogenous insulin secretion, the hypothalamus can be further characterized in its role with dysglycemia and diabetes. The hypothesis of this study is that hypothalamic neuronal activity will demonstrate a synchronous relationship with the pulsatile release of endogenous insulin in response to induced mild hyperglycemia in five healthy adult males. Ultimately, we found statistically significant changes in BOLD signal from the baseline to hyperglycemic state in the left medial hypothalamus (MNI coordinates [-4, -4, 8]). Although further data acquisition and synchronicity analyses must be performed, preliminary qualitative analysis of the data suggests that there is some degree of synchronicity between the endogenous insulin pulsing and hypothalamic BOLD signal oscillation after the induction of a hyperglycemic state.

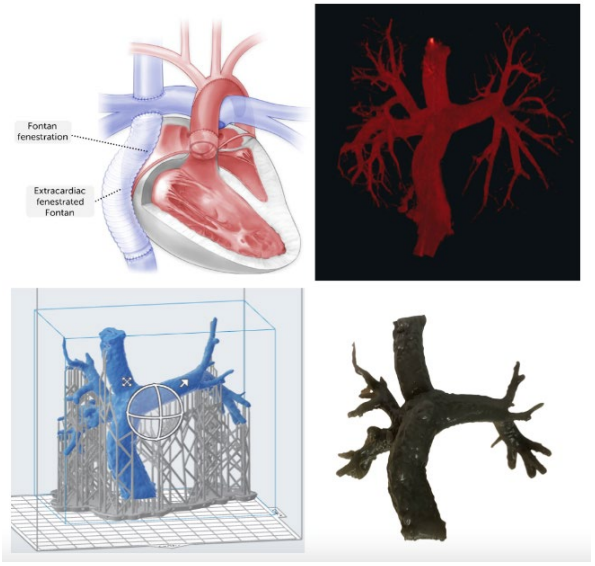


Poster #12 Amanda Telfer

An Evaluation of 3D Printed Cardiac Models and Their Role in Patient, Caretaker, and Staff Education: One Print, Multiple Uses

Capstone Committee: Danielle Royer (chair), Jenny Zablah (mentor), Michael Shorofsky

ABSTRACT:
Understanding complex and atypical cardiac anatomy has historically presented a challenge for patients and medical staff, particularly when two dimensional (2D) images are the most commonly used educational tool and may not be ideal for conceptualization of intricate three dimensional (3D) relationships. Patient-specific models that accurately replicate both anatomic and functional characteristics allow viewers to see details of cardiovascular anatomy without distorting relationships to nearby structures, thereby presenting an opportunity for deeper understanding of cardiac anatomy for all persons involved in the treatment of a congenital heart defect. While the general utility of employing 3D prints as an educational tool has been investigated and confirmed, further research is necessary to uncover how useful 3D printed heart models are for pediatric patients, their caretakers, and staff involved in caring for a patient as compared to other available alternatives. Quantifying improvements in spatial comprehension and understanding will allow healthcare providers to discern which medical circumstances are most appropriate for the use of personalized 3D models. In an IRB approved protocol, patient-personalized models derived from 3D rotational angiography (3DRA) scans were used alongside angiograms, computerized tomography (CT) scans, magnetic resonance images (MRI), drawings, and diagrams to describe anatomical modifications performed during cardiac catheterization or surgical interventions. Patients/caretakers (N =13) and staff (N=15) completed surveys used to assess spatial comprehension and understanding of atypical pediatric cardiac anatomy and preference for a personalized 3D model as an educational tool. Retrospectively, patients, caretakers, and staff were asked to assign a value to their understanding of relevant cardiac anatomy prior to exposure to any educational materials, after exposure to 2D resources, and after exposure to a personalized 3D printed model. On average, both patient/caretaker and staff groups demonstrated an increased understanding of at least 15% when explanations of surgically modified or atypical cardiac anatomy supplemented with 2D resources were followed with patient-specific 3D printed models. A significant increase ($p < 0.05$) in self-reported understanding values from baseline values to post-3D resource values was found for both the patient/caretaker and staff group. This suggests the value of utilizing 3D models alongside images obtained from traditional modalities to improve understanding of cardiac anatomy. A majority of respondents in both groups demonstrated a preference for 3D printed models as an educational tool, followed closely by a preference for a well-rounded complement of all available educational materials including traditional images, hand drawn images, and 3D models. Widespread use of patient-specific 3D models will increase confidence in patients and families as well as healthcare providers and support staff and may provide an avenue for deeper anatomic comprehension that is unavailable using other means.

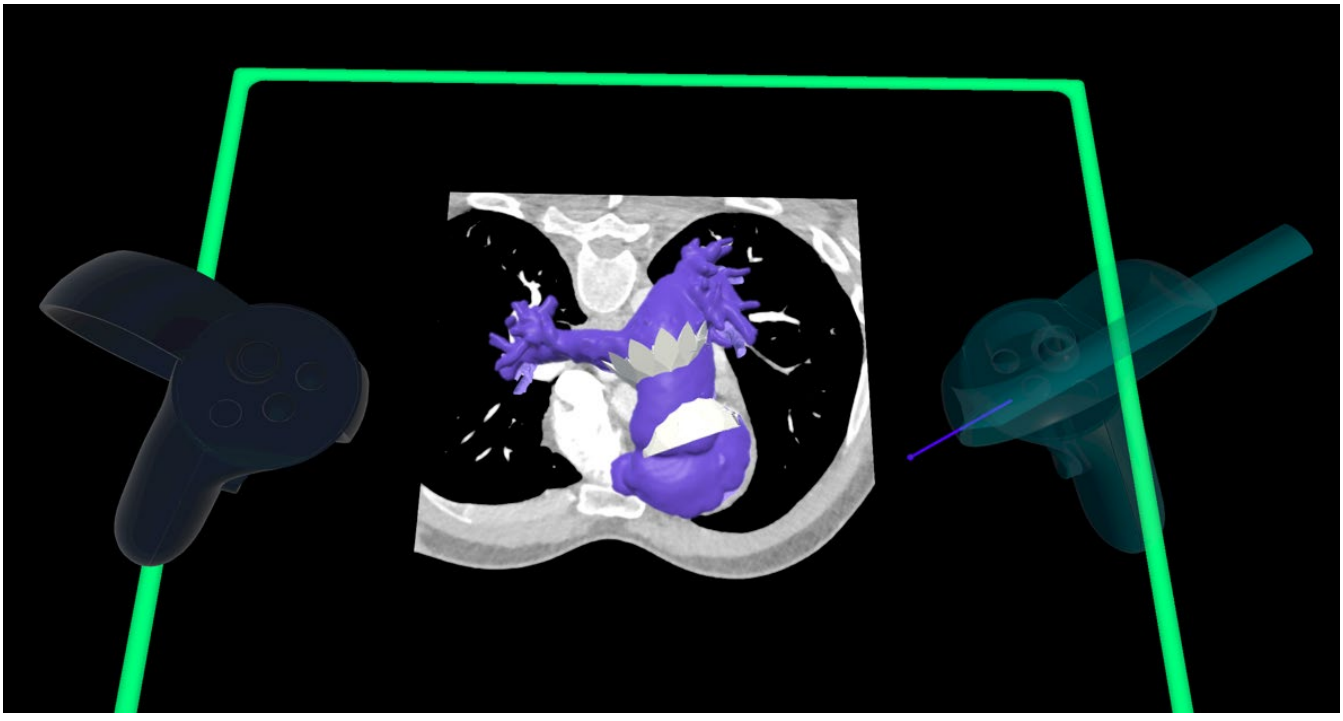


Poster #13 Jeannie Than

Step Into Another World: Virtual Reality Applications in the Cardiac Catheterization Laboratory for Patients with Congenital Heart Disease

Capstone Committee: Ernesto Salcedo (chair), Jenny Zablah (mentor), Gareth Morgan

ABSTRACT:
Percutaneous pulmonary valve implantation procedures are performed to help treat pulmonary regurgitation in congenital heart disease patients. In this procedure, patients are implanted with a self-expandable valve like the Harmony TPV (Medtronic) or Alterra Prestent (Edwards Lifescience). Currently, patients must be screened for valve candidacy through a third-party company, however, this can delay treatment. Recent studies have shown that virtual reality (VR) has shown promise in the surgical field and could potentially be used as a tool to remedy the delay in treatment and the lack of tools available for physicians to determine valve candidacy for patients. This study was conducted to evaluate the hypothesis that virtual reality can be used as a reliable screening tool to test valve candidacy for PPVI eligible patients. Dynamic 3D heart models were created from 24 patient CT scans using Elucis (Realize Medical). Two congenital interventional cardiologists then used Elucis in a VR platform to perform a simulation of valve placement to determine the suitability of the self-expandable valves for each patient case. The physicians' evaluations were then compared with the actual clinical outcome using a kappa coefficient test. The companies' recommendations were also compared to the clinical outcome. Results showed a Cohen's kappa value of 0.56 and 0.43 respectively between the two groups. This study showed that the VR device was useful in helping physicians determine the feasibility of using self-expanding valves from the virtual 3D models. It also showed that the VR device had comparable agreement rates to the third-party company screening processes.



Poster #14 Ryan Wendell

The Role of Pain in Gait Deviations Caused by Unilateral Hip Osteoarthritis

Capstone Committee: Ernesto Salcedo (chair), Cory Christiansen (mentor), Hope Davis-Wilson

ABSTRACT:
Hip osteoarthritis is known to cause changes to gait kinematics and induce asymmetric gait patterns that contribute to the progression of the disease. Several factors related to these deviations have been identified however, previous study has been inconsistent in identifying a relationship between these gait deviations and pain. Recently, wearable sensors have become a tool to study biomechanics, but their utility for studying pathologic gait patterns needs further testing. We believe a wearable sensor system facilitates study of continuous gait that allows us to identify relationships with pain in a novel way. Our purpose was to investigate the relationship between pain and gait deviations caused by unilateral hip osteoarthritis as well as investigate the utility of wearable sensors for measuring pathologic gait kinematics. We hypothesized that wearable sensors would be effective in measuring pathologic gait and that pain would be related to more severe gait deviation and asymmetry. To test this, we used inertial measurement unit (IMU) enabled wearable sensors to measure frontal and sagittal plane gait kinematics of the hip, trunk, and knee in 19 participants with end-stage hip osteoarthritis during a 6-minute walk test (6MWT). We found gait deviations consistent with hip osteoarthritis that did not change significantly over 6-minutes as well as some weak associations between pain and peak hip extension, peak hip abduction, and hip abduction asymmetry. This study found that pain is involved in gait deviations caused by hip osteoarthritis and that wearable sensors are effective for tracking kinematics of pathologic gait during overground walking.