



Modern Human Anatomy Program

UNIVERSITY OF COLORADO
ANSCHUTZ MEDICAL CAMPUS

Capstone Project Poster Presentations

Monday, April 17, 2017

**2017 Modern Human Anatomy Program
Capstone Poster Presentations
Agenda**

April 17, 2017

8:30 AM – 9:00 AM	Breakfast available, students arrive
9:00 AM	Welcome and overview, Dr. Mike Pascoe
9:00 AM – 10:30 AM	Presentation for Session I posters
10:30 AM – 12:00 PM	Presentations for Session II posters
12:00 PM – 1:00 PM	Lunch
12:45 PM	Presentation of Outstanding Poster Award and Invited Capstone Oral Presenters

Session I Poster Presenters

9:00 AM – 10:30 AM

Capstone Poster Presenter	Poster #	Abstract Page #	Poster Title
Clara Bacmeister	1	5	The Differential Targeting of Nav1.6 in Superficial Cortical Axons with Intermittent Myelination
Briauna Blezinski	2	6	To Model or Not To Model Embryological Development, That is the Educational Question
Benjamin Culleen	3	7	Quantitative and Qualitative Analysis of a Brief Histology Quiz Tool
Tawnya Harvey	4	8	Evaluation of a New 3D-sectioned Heart Model and Facilitator's Guide for Cardiac Ultrasound Training
Rachel Klaus	5	9	Use and Perceptions of Plastination Among Anatomy Medical Educators in the United States
Jacob Smith	6	10	"TIPS" for Developing a Learning Module on Transjugular Intrahepatic Portosystemic Shunt (TIPS) Creation
Emily Swenson	7	11	Quantitative Analysis of Cell Movement during Mammalian Neural Tube Closure
Laura Weinkle	8	12	Quantitative measures of brain MRI as a predictive factor of cognitive outcomes after Subthalamic Nucleus Deep Brain Stimulation for Parkinson's disease
Avery Williams	9	13	Sexual Dimorphism in Bones of the Thenar and Hypothenar Aspects of the Hand
Jennifer Yates	10	14	Sugar Induced Pulmonary Hypertension and the Role of Mast Cells

Session II Poster Presenters

10:30 AM – 12:00 PM

Capstone Poster Presenter	Poster #	Abstract Page #	Poster Title
Stefan Adrian	11	15	Tesamorelin Effect on Skeletal Muscle Fat in HIV+ Patients
Hannah Benjamin	12	16	Interactive Digital Anatomy to Improve Caregiver Understanding in the Aerodigestive Clinic
Shannon Curran	13	17	A Flipped Classroom Design for Circulatory System in Medical School Gross Anatomy: Impact on Student Performance and Attitudes
Johnna Diouf	14		Creation and Testing of an ALS Learning Module for Healthcare Graduate Students
Johna Iannitto	15	18	Assessment of commonly used measures of lower extremity swelling following total knee arthroplasty
Molika Keeler	16	19	The use of a novel Anatomical Mental Rotation Test to enhance understanding of repetitive visual-spatial training on learning outcomes in a human anatomy course
Matthew Mecredy	17	20	Estimating Anthropoid Primate Body Mass from Carpal Bone Volume
Jason Nadeau	18	21	Novel 3D Modeling and Measurement of the Left Atrial Appendage to Facilitate Watchman™ Device Implantation
Lucine Papazian	19	22	Correlation of Type II Diabetes Mellitus Glomerulopathy with Pancreatic Morphometry
Alejandro Sigala	20	23	3D Analysis of the Human Aortic Root to Guide Transcatheter Aortic Valve Replacement with SAPIENT™ and Evolut™ R Devices
Hermella Yilma	21	24	Structural changes associated with duration of subthalamic nucleus deep brain stimulation in patients with Parkinson's disease with a focus on olfactory processing

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

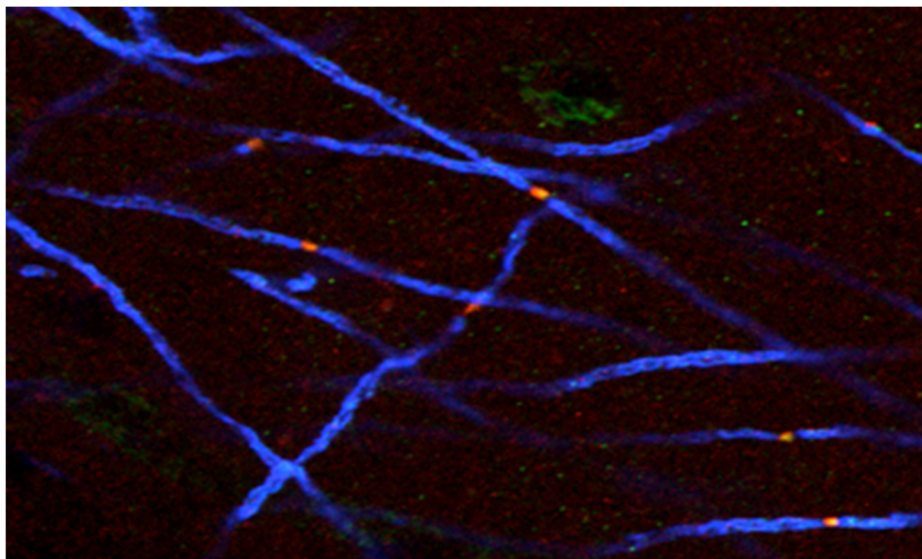
MSMHA Student	Capstone Committee Chair	Capstone Mentor	Committee Member	Committee member
Adrian, Stefan	John Caldwell	Kristine Erlandson	Ann Scherzinger	
Bacmeister, Clara	John Caldwell	Ethan Hughes	Levinson, Rock	
Benjamin, Hannah	Ernesto Salcedo	Emily DeBoer	Joel Friedlander	Sparrow Helland
Blezinski, Briauna	John Caldwell	Lisa Lee	Jennifer Stratford	
Culleen, Benjamin	Norma Wagoner	Lisa Lee	Jennifer Stratford	
Curran, Shannon	John Caldwell	Danielle Royer	Mike Carry	
Diouf, Johnna	Danielle Royer	Mike Pascoe	Steven Ringel	
Harvey, Tawnya	Maureen Stabio	Danielle Royer	John Kendall	
Iannitto, Johna	Danielle Royer	Jennifer Stevens-Lapsley	Mike Pascoe	
Keeler, Molika	Maureen Stabio	Danielle Royer	Brent Wilson	
Klaus, Rachel	Danielle Royer	Maureen Stabio	Janet Corral	
Mecredy, Matt	Mike Pascoe	Caley Orr	Jamie Hodgkins	
Nadeau, Jason	Ernesto Salcedo	James Chen	Lisa Lee	
Papazian, Lucine	Ernesto Salcedo	Lisa Lee	Zenggang Pan	Francisco LaRosa
Sigala, Alejandro	Norma Wagoner	James Chen	Ernesto Salcedo	
Smith, Jacob	Caley Orr	Paul Rochon	Kimi Kondo	John Caldwell
Swenson, Emily	Norma Wagoner	Lee Niswander	Caley Orr	
Weinkle, Laura	John Thompson	Brian Hoyt	Ernesto Salcedo	
Williams, Avery	Royer, Danielle	Caley Orr	Jamie Hodgkins	
Yates, Jennifer	Ernesto Salcedo	MyPhuong Le	Leah Villegas	
Yilma, Hermella	John Caldwell	John Thompson	Ernesto Salcedo	Nicole Garneau

Session I: 9:00 AM – 10:30 AM**Poster #1 Clara Bacmeister*****The Differential Targeting of Nav1.6 in Superficial Cortical Axons with Intermittent Myelination***

Capstone Committee: John Caldwell (chair), Ethan Hughes (mentor), Rock Levinson

ABSTRACT:

Disruption of nodal sodium channel localization plays a key role in the pathophysiology of demyelinating disorders. The recent discovery of diverse myelin profiles in the cortex, termed intermittent myelination, reveals the necessity for further understanding of myelin structure and function in the brain. Myelin plays varied and important roles in the central nervous system, including participation in the formation and maintenance of nodes of Ranvier, but little is known about the ion channel properties in cortical neurons with intermittent myelination. Understanding the cognitive effects of intermittent myelination has important implications for diseases involving damaged myelin. To evaluate the capacity of axons with intermittent myelination to influence action potential, we used immunohistochemical analysis of superficial cortical sections to characterize the sodium channel distributions at heminodes distal to isolated and terminal myelin sheaths. A differential distribution of sodium channels was found at isolated, terminal, and continuous heminodes and a subset of isolated and terminal heminodes showed no sodium channel immunoreactivity. Further, Nav1.6 was absent at the majority of isolated and terminal heminodes. Together, these data indicate that the differential targeting of sodium channel isoforms to heminodes in the superficial cortex is dependent on the distribution of myelin.



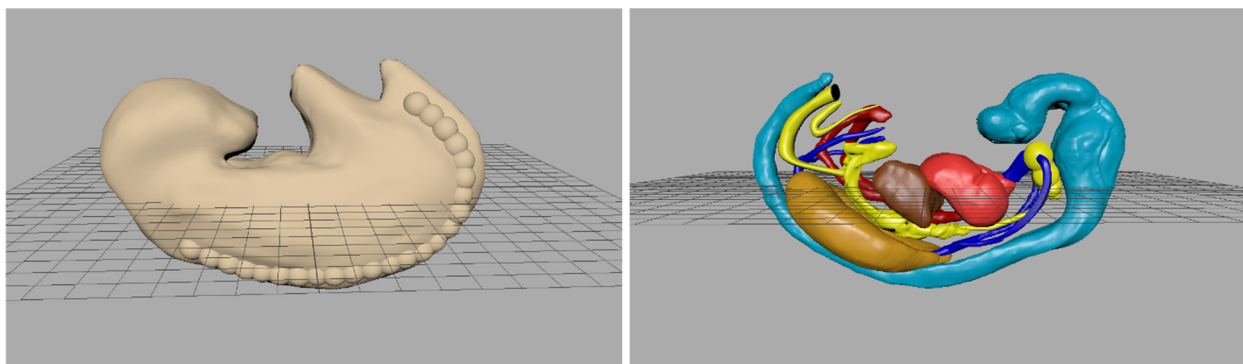
Poster #2 Briauna Blezinski

To Model or Not To Model Embryological Development, That is the Educational Question

Capstone Committee: John Caldwell (chair), Lisa Lee (mentor), Jennifer Stratford

ABSTRACT:

Embryology, the study of embryonic development, is perhaps one of the most difficult subjects in anatomical sciences due to; the complex, 4-dimensional processes that occur in a short time frame, the reduction in instructional contact hours in graduate and medical curricula, lack of effective visual resources, and paucity in literature on best embryology educational practices. Thus, the overall goals of the project were to assess the educational value of the virtual and 3D printed heart development models created from 2D textbook diagram, and then to create a complete embryo model based on histological cross-sections. For the first part of this study, first year medical, dental and graduate students were recruited to take a pre-quiz, have an interactive session with the heart models, then complete a post-quiz and survey. Data analyses revealed that interacting with the virtual and/or printed heart models yielded a significant learning outcome. Students perceived both resources to be educationally valuable, with a preference for the 3D printed models. Based on the feedback from the first part of the study, an anatomically accurate, whole embryo model was developed from segmentation of serial embryo tissue slides. The histology slides were segmented and rendered into a 3D virtual model, using FIJI-ImageJ. The virtual model was then imported into Maya for further smoothing and modeling. The completed virtual model dataset was then 3D printed to produce a physical model. Investigating the educational value of the complete embryo model will be an important future direction to propel embryology education forward.



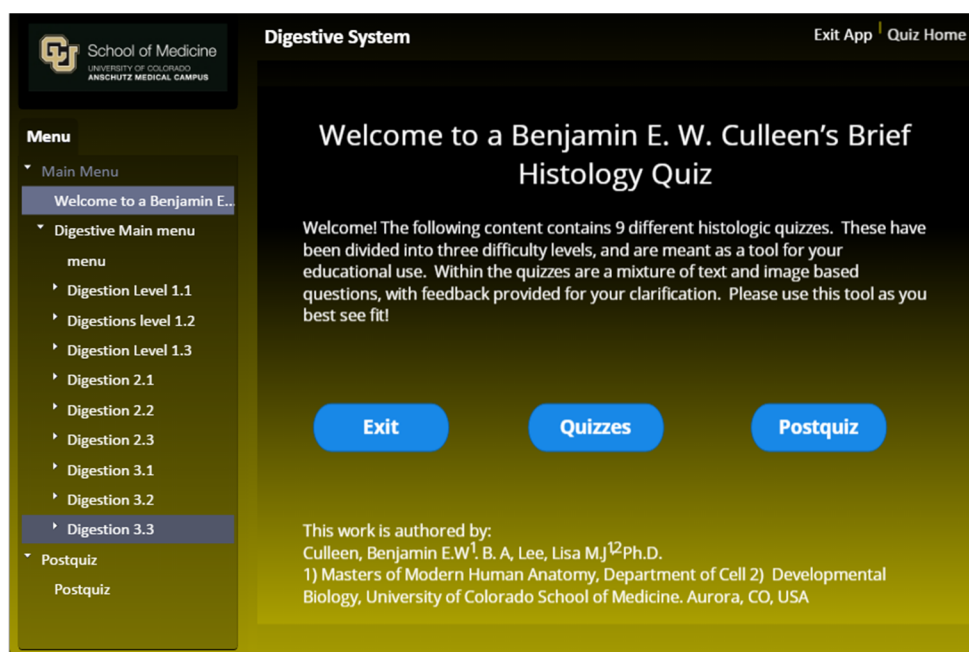
Poster #3 Benjamin Culleen

Quantitative and Qualitative Analysis of a Brief Histology Quiz Tool

Capstone Committee: Norma Wagoner (chair), Lisa Lee (mentor), Jennifer Stratford

ABSTRACT:

Virtual histology has now become the norm in histology curricula. However, there has been little evidence of an increase in students' learning outcome with its use. Previous studies by this group revealed that instructor simulator applications yield a higher learning outcome rather than the virtual lab alone. Therefore, the purpose of this study was to develop a set of digital self-assessment tools (Brief Histology Quizzes—BHQs). BHQs would expand the library of, and accessibility to, instructor simulator tools. BHQs are designed to assess users' histology competency in 3 incremental levels. Level 1 explores baseline knowledge, such as an ability to define or identify key structures. Level 2 examines understanding of more complex concepts and ability to identify difficult or complex histological features. Level 3 probes the analytic, evaluative and integrative abilities of the user. A total of eighteen, approximately 10-item, BHQs were created using Articulate Storyline™; nine on the Digestive System and nine on Connective Tissue topics. Each BHQ features image or text based questions; users also receive instant feedback for each item, including some pitfalls or commonly misidentified structures, or background information. This feature of the BHQ is unique; no other app or tool available provides the combination of image and text based questions, with such robust feedback. These BHQs were user-tested with graduate students who have previously completed a histology course. The survey included metrics on the BHQ interface design, quality of the assessments, and perceived educational value. Results reveal an overall positive perception on the design, organization and educational value. BHQs that simulate short, on-demand instructor-interactions with appropriate feedback on digital platforms may be a powerful, and desired, learning tool for students in the current educational environment.



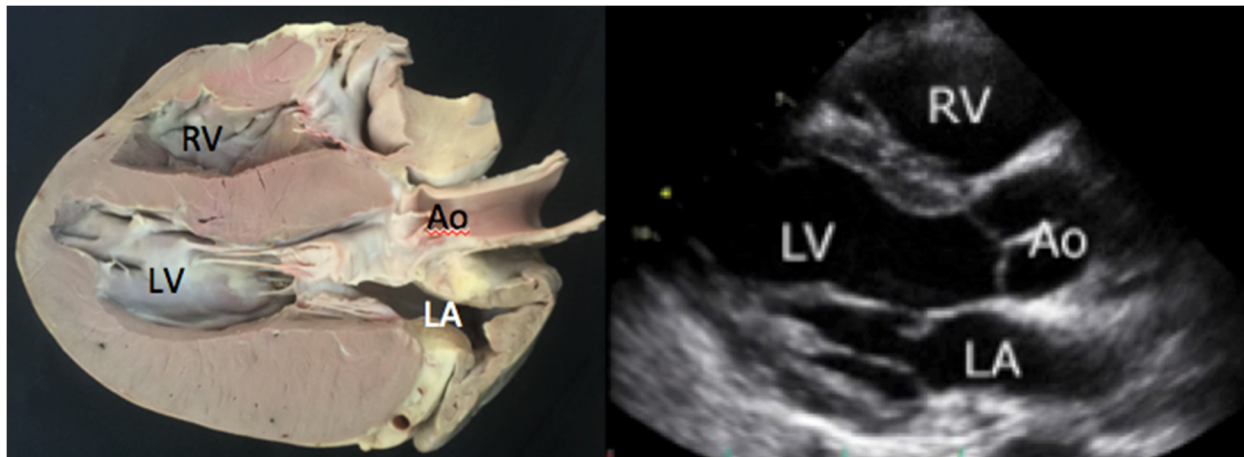
Poster #4 Tawnya Harvey

Evaluation of a New 3D-sectioned Heart Model and Facilitator's Guide for Cardiac Ultrasound Training

Capstone Committee: Maureen Stabio (chair), Danielle Royer (mentor), John Kendall

ABSTRACT:

Point-of-care ultrasound is ubiquitous in clinical practice today. Novice users find learning cardiac ultrasound to be especially challenging, and often struggle to understand the orientation of the heart, its relationship to surface anatomy for probe placement, and how to relate internal heart anatomy to standard B-mode ultrasound views. The goal of this study is to determine if 3D-sectioned heart models are an effective aide for learning cardiac ultrasound. Using fixed pig hearts – anatomically similar to human hearts – six sectioned models depicting parasternal long axis (PLAX) and parasternal short axis (PSAX) views of the heart were created. A Step-by-Step Photographic Guide outlines how to replicate the models, and a Facilitator's Guide provides instruction on how to incorporate the models into a cardiac ultrasound training session. The sectioned hearts were provided to first year medical students ($N = \#$) during their hands-on thoracic ultrasound lab. Students were surveyed to determine their attitudes toward the use of the sectioned hearts as an aide to ultrasound training. 43.5% of students utilized the models both before and during their attempts at cardiac scanning. Mean usefulness ratings for both PLAX and PSAX sections were very positive (4.28 ± 0.74 and 4.21 ± 0.79 respectively on a Likert-scale 1-5, $p > 0.05$). Results indicate the perceived benefit of the new teaching aides for ultrasound training in medical education. Plastinated, sectioned human hearts are being developed to further supplement student training in ultrasound. The Guides will be disseminated, allowing other institutions to benefit from this new resource.



Poster #5 Rachel Klaus

Use and Perceptions of Plastination Among Anatomy Medical Educators in the United States

Capstone Committee: Danielle Royer (chair), Maureen Stabio (mentor), Janet Corral

ABSTRACT:

Traditionally, medical schools have maintained collections of cadaveric tissues and organs to engage students in anatomy. Such collections are often stored in preservative solutions that are toxic, volatile and carcinogenic. Plastination is an alternative tissue preservation technique in which the water and lipids are replaced with polymers. Thus, the tissues are as benign as a manufactured plastic model, yet anatomically authentic. Plastination was popularized by Body Worlds and Body Works exhibits and is used in medical education internationally; however, its use within U.S. medical schools is not widely discussed in the anatomical literature. Among the 786 peer-reviewed articles about plastination from 1977-2016, 15% are from U.S. institutions. The objective of this study was to determine the use and perceptions of plastination as an anatomical teaching tool among medical educators in the U.S. A 16-item survey was developed in Qualtrics© and approved by the Colorado Multiple Institutional Review Board. Question types included multiple choice, free response, semantic differential, dichotomous and contingency based. Survey items focused on four main areas: (1) availability and use of cadaveric dissection, (2) familiarity with plastination, (3) integrations of plastination in current curriculum, and (4) perceptions of plastination as a teaching tool. Survey invitations were posted on the American Association of Anatomists Open Forum and emailed to anatomy course directors at 139 allopathic (MD) and 38 osteopathic (DO) schools nationally. Descriptive statistics were performed using SAS. 120 U.S. anatomists completed the survey; 68% indicated they teach MD students (n=81), and 19% teach DO students (n=23). Analysis was restricted to these 98 respondents representing 77 medical schools across 37 states. Of these, 100% had heard of plastination, 78% had attended a Body Worlds and Body Works exhibit, but less than 40% currently utilize plastinates for medical anatomy education. When prompted to explain why plastination is not used, several themes emerged. Most prominently was a preference for the dissection experienced, followed by cost, availability, lack of resources and negative past experiences related to durability and quality. 75% of medical anatomy educators perceived plastination as a good supplement to, but not a replacement for, dissection, 19% indicated no curiosity to use plastination or considered it not useful, 10% expressed ethical concerns about plastination in general, and only 1% considered plastination a good alternative to replace dissection. These findings suggest that plastinates are more widely used in the U.S. than reflected by the literature; however, perceptions regarding their utility are varied with a dominant theme towards their use to supplement, but not replace, cadaveric dissection.

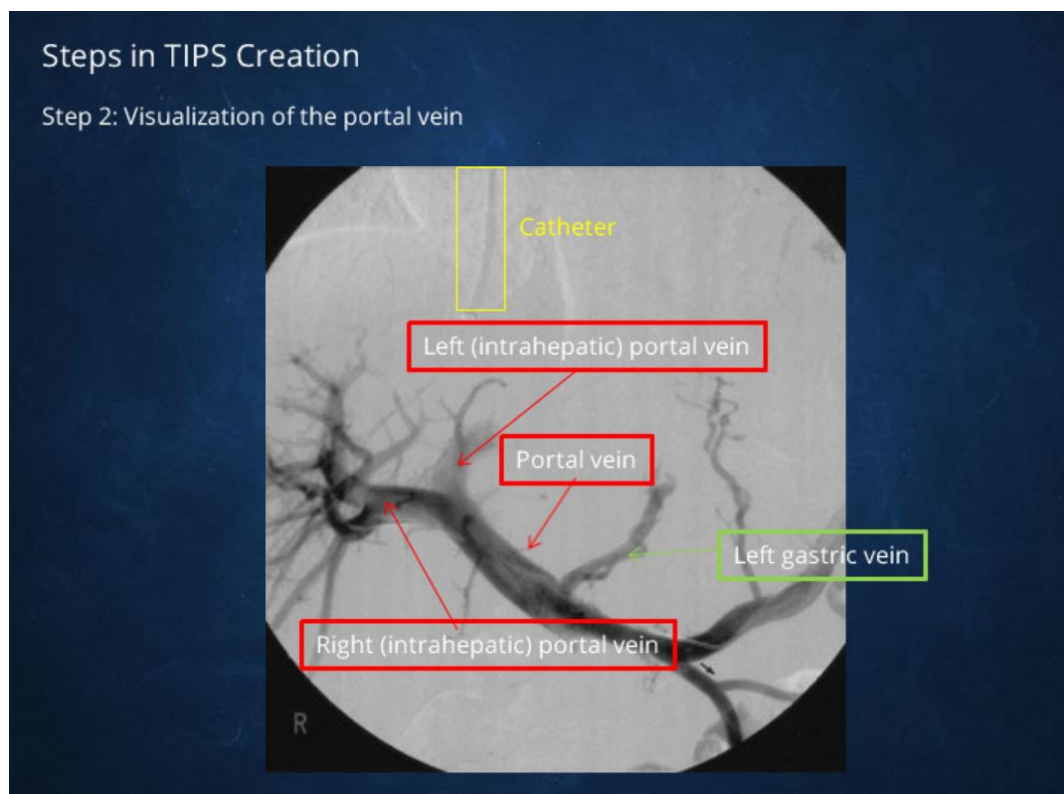


Poster #6 Jacob Smith***“TIPS” for Developing a Learning Module on Transjugular Intrahepatic Portosystemic Shunt (TIPS) Creation***

Capstone Committee: Caley Orr (chair), Paul Rochon (mentor), Kimi Kondo, John Caldwell

ABSTRACT:

Portal hypertension (PH) is a clinical condition that refers to high blood pressure within the hepatic portal vein- the structure that transmits blood from the abdomen to the liver. Patients with PH are at risk for developing esophageal varices, which are formed when blood within the portal vein flows through points of portosystemic collateral circulation in order to return to the right atrium. One treatment option for complications of PH is creation of a transjugular intrahepatic portosystemic shunt (TIPS). The goal of this study is to describe and evaluate an asynchronous interactive learning module designed for graduate anatomy students which covers anatomical and clinical concepts important for understanding when and why TIPS creation is indicated. To determine the efficacy of the learning module, a pre-test and post-test method was used. There were a total of 11 graduate anatomy student respondents with an average pre-test score of 9.73 ± 2.45 out of 20 questions (48.64%) correct, and an average post-test score of 12.55 ± 2.84 out of 20 questions (62.73%) correct ($p=0.0197$). The significant increase in test scores shows great promise for the learning module to be improved upon and distributed to medical students, PGY1 interventional radiology interns, and PGY2+ interventional radiology residents.

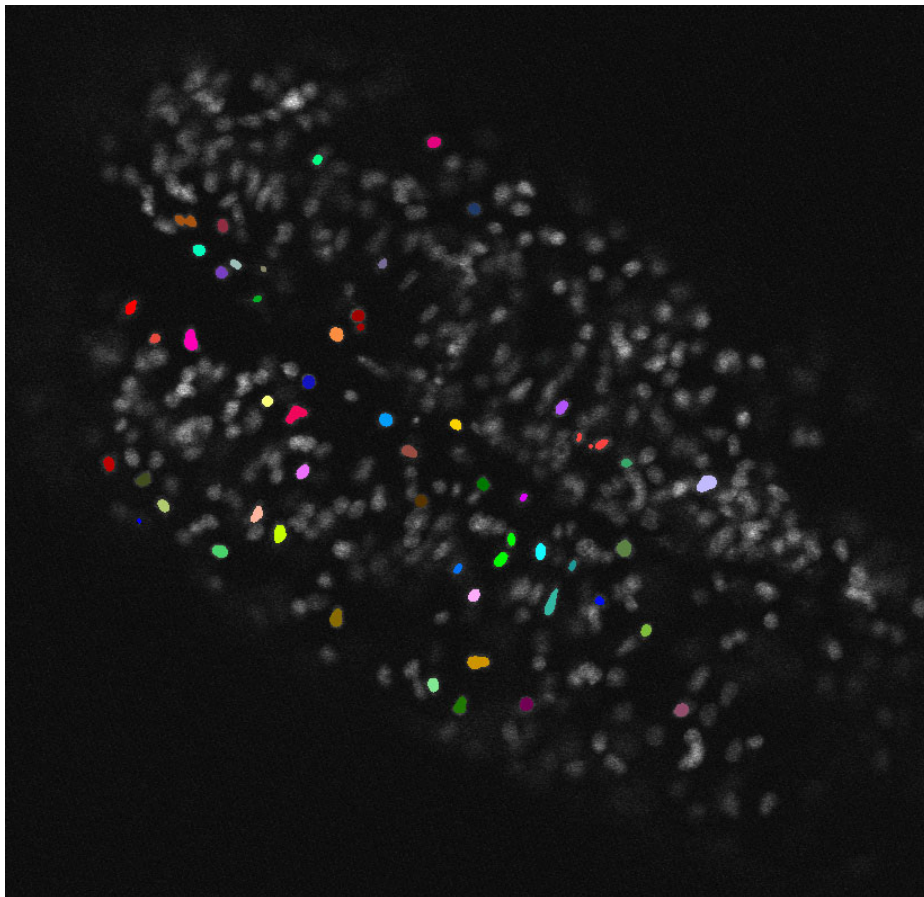


Poster #7 Emily Swenson***Quantitative Analysis of Cell Movement during Mammalian Neural Tube Closure***

Capstone Committee: Norma Wagoner (chair), Lee Niswander (mentor), Caley Orr

ABSTRACT:

Neural tube closure (NTC) is essential to the formation of the central nervous system in vertebrates. Failure of this process leads to neural tube defects (NTDs) that affect 1 in 1000 live births worldwide. Recent advances in ex-vivo culture techniques combined with live imaging have allowed for the study of dynamic processes in mammalian NTC. While we can quantitatively assess cell morphology and movement in 2D over time, similar studies in 4D are limited to costly software and highly intricate mathematical analysis. Here we have employed the use of inexpensive and user-friendly software to develop a workflow for analysis of cell movement in 4D. Future use of this workflow, applied to 4D images of mouse embryos, will contribute to a better understanding of mammalian NTC and NTDs.



Poster #8 Laura Weinkle

Quantitative measures of brain MRI as a predictive factor of cognitive outcomes after Subthalamic Nucleus Deep Brain Stimulation for Parkinson's disease

Capstone Committee: John Thompson (chair), Brian Hoyt (mentor), Ernesto Salcedo

ABSTRACT:

Significant declines following subthalamic nucleus deep brain stimulation (STN-DBS) in domains such as verbal fluency, and attention are reported. However, predictors of cognitive decline in idiopathic Parkinson's disease (iPD) patients treated with STN-DBS are not well-known. Thus, identification of pre-surgical MRI predictors might provide an important clinical tool for better risk-to-benefit assessment. This study explored whether white matter lesion volume, or brain region volumes, measured quantitatively on brain MRI, predict cognitive outcomes following STN-DBS in iPD patients. Retrospective data, and pre-surgical and ≥ 6 -month post-surgical neuropsychological (NP) evaluation scores from 43 patients with STN-DBS was collected. White matter lesions, and bilateral brain regions were segmented and quantified from T2-FLAIR MRI, or 3D T1-weighted MRI, respectively. Mean pre/post NP test scores for measures of executive function, attention, verbal fluency, memory, and visuospatial function were analyzed. Correlation between log (lesion volume), bilateral brain region volumes, and changes in performance on cognitive tests was investigated, covarying for age, education, and vascular risk factors. Cognitive measures of verbal fluency, executive function, attention, and visuospatial function showed significant declines. Log (lesion volume) and bilateral brain region volumes were weak and not correlated with cognitive outcomes for most cognitive measures. Larger lesion volume correlated with impaired performance on a visuospatial task, while increased performance on an attention task correlated with greater bilateral forebrain parenchyma volume. These results demonstrate that post-STN-DBS cognitive impairments are largely independent of pre-surgical lesion and brain region volumes, suggesting these neuroanatomical changes, do not put DBS candidates at an increased risk for cognitive impairments.

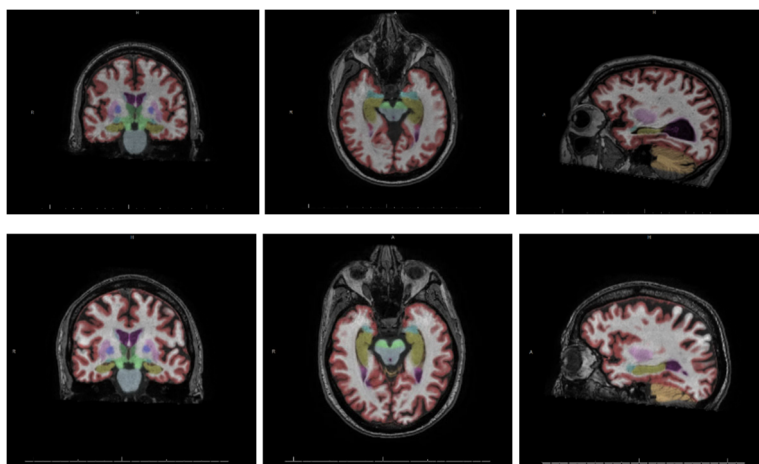


Figure 4

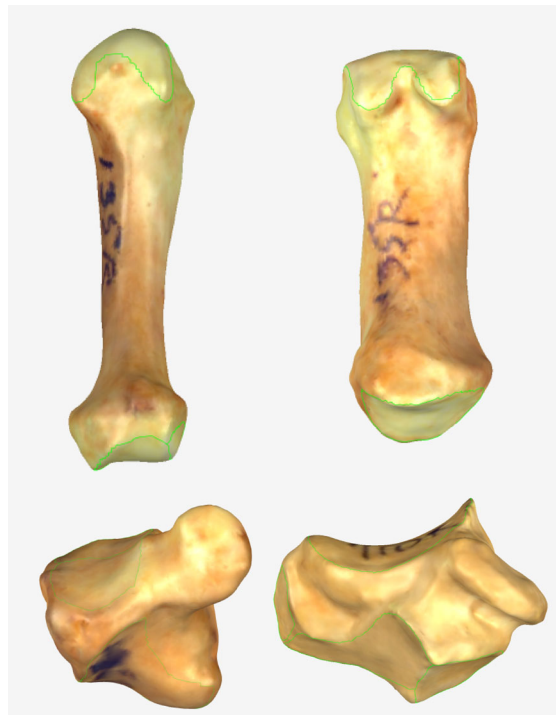
Pre-surgical 3D-T1 segmented brain regions showing forebrain parenchyma in red and hippocampi in yellow, from left to right, coronal, axial, and sagittal section.

Poster #9 Avery Williams***Sexual Dimorphism in Bones of the Thenar and Hypothenar Aspects of the Hand***

Capstone Committee: Danielle Royer (chair), Caley Orr (mentor), Jamie Hodgkins

ABSTRACT:

Several hypotheses have been proposed to explain why osteoarthritis of the hand is most prevalent in females, including that it is a product of sexual dimorphism in joint morphology. If female joints are smaller relative to muscle strength, then higher transarticular stresses might contribute to higher rates of osteoarthritis. As a preliminary test, we investigated bones composing the first and fifth carpometacarpal articulations in a sample of 60 humans of African and European descent. These joints underlie the thenar and hypothenar compartments, which are key contributors of grip strength. We predicted that females have bones that are smaller in overall size, individual joint surfaces that are smaller both absolutely and relative to proxies for muscularity (shaft surface area and length of the hamate's hamulus), and opposing joint surfaces that are less congruent. The trapezium, first metacarpal (Mc1), fifth metacarpal (Mc5), and hamate of each individual were 3D laser scanned. Bone volume and surface area were calculated along with the areas of individual joints. Dorsovolar and radioulnar curvatures of the Mc1 and trapezium carpometacarpal surfaces, and the length, robusticity, and distal angulation of the hamate's hamulus were also measured. The results indicate that females have bones that are significantly smaller in overall size with correspondingly smaller joints. Females also exhibit dorsovolarly flatter proximal Mc1 surfaces resulting in significantly less congruent carpometacarpal joints. Finally, females exhibit significantly smaller proximal Mc5 joints relative to both the length of the hamulus and the Mc5 shaft areas, suggesting greater stress at the fifth carpometacarpal joint.



Poster #10 Jennifer Yates***Sugar Induced Pulmonary Hypertension and the Role of Mast Cells***

Capstone Committee: Ernesto Salcedo (chair), MyPhuong Le (mentor), Leah Villegas

ABSTRACT:

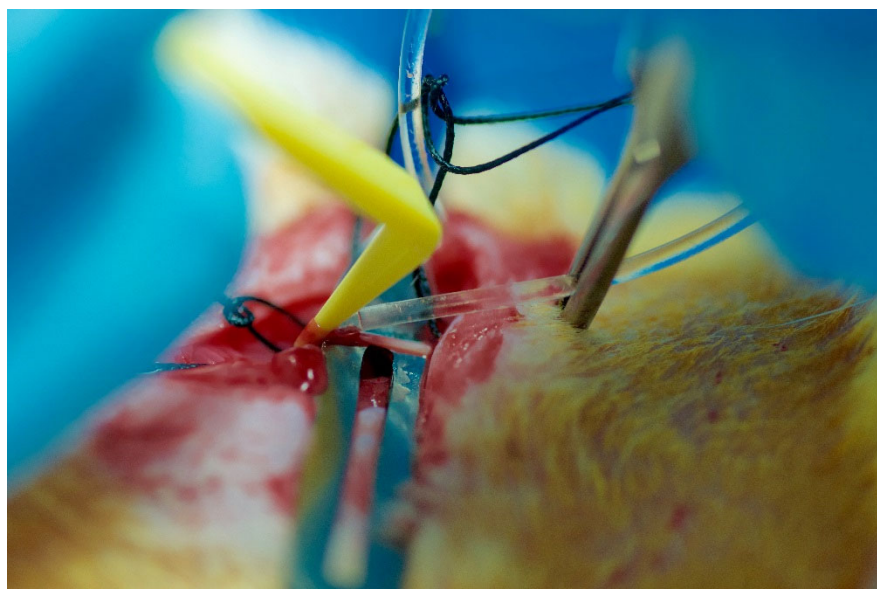
Objective: This study looks at if high sugar diets can induced pulmonary hypertension (PH) and if mast cells play a roll in causing the inflammation that induces the vessel damage and comorbidities seen in PH.

Materials/Methods: Male Sprague Dawley rats were fed a standard chow diet and randomized to drink *ad libitum* water, 15% fructose, or 30% sucrose (n = 9 per treatment) for 8 weeks of treatment. Systemic, pulmonary artery, and right ventricular blood pressures were measured before sacrifice. Tissues, blood, urine, and feces were collected at sacrifice and stored at -80°C. The heart was dissected for right ventricular hypertrophy. The lung was analyzed for the presence of mast cells by toluidine blue staining.

Results: The 15% fructose treatment group had a significant average systemic pressure of 109.3mmHg (p=0.0054). Though not significant the pulmonary artery pressures and right ventricular pressures were higher in the 15% fructose treatment group than both the 30% sucrose treatment group and the control group. The 15% fructose treatment group also had a significant presence of granulated mast cells surrounding the root of the lung with an average positive pixel count of 5.07% (p=0.0335) when compare with both other treatment groups. All treatment groups had similar measurements for right ventricular hypertrophy (RVH).

Conclusions: The 15% fructose treatment group showed a trend that high sugar diets induce PH and have an increased presence of mast cells in the lung tissue. More data is needed to conclude that sugar diets lead to RVH.

Picture: Close up of surgical catheter insertion for Right Ventricular Pressure and Pulmonary Artery Pressure in a rat.



Session II: 10:30 AM – 12:00 PM

Poster #11 Stefan Adrian

Tesamorelin Effect on Skeletal Muscle Fat in HIV+ Patients

Capstone Committee: John Caldwell (chair), Kristine Erlandson (mentor), Ann Scherzinger

ABSTRACT:

People infected with human immunodeficiency virus (HIV) accumulate visceral adipose tissue (VAT) to a greater extent than people without HIV. VAT correlates with skeletal muscle fat, a marker of “muscle quality.” Tesamorelin, a growth-hormone-releasing hormone analog, is effective in reducing VAT in some HIV-infected patients with lipodystrophy. We hypothesized tesamorelin can also reduce skeletal muscle fat compared to placebo. CT scans (L4-L5) from two multicenter, randomized (2:1) clinical trials of tesamorelin vs placebo were analyzed to quantify skeletal muscle area and density using an image analysis program (IDL). Tesamorelin participants were restricted to responders (VAT decrease $\geq 8\%$). Differences between muscle area and density before and after treatment, for both study arms, were compared using t-tests. Tesamorelin (n=193) and placebo (n=148) participant characteristics at baseline were similar, and were mostly Caucasian (82.7%) and male (86.8%). Compared to placebo, tesamorelin was associated with significant increases in total and lean muscle area, as well as total and lean muscle density (most comparisons reached statistical significance). Among responders, tesamorelin was effective in reducing skeletal muscle fat. Long term effectiveness and the impact of these changes in daily life should be further studied.

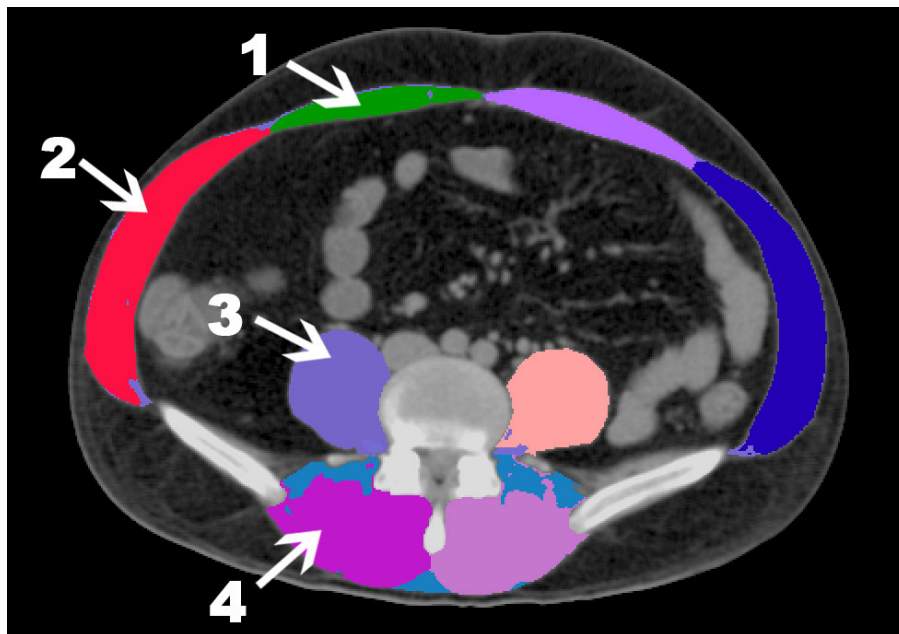


Figure: Axial computed tomography obtained at the L4-L5 region showing: 1) rectus abdominis muscle, 2) anterolateral abdominal muscles (external oblique, internal oblique and transversus abdominis), 3) psoas major muscle, and 4) paraspinal muscles (erector spinae and transversospinalis).

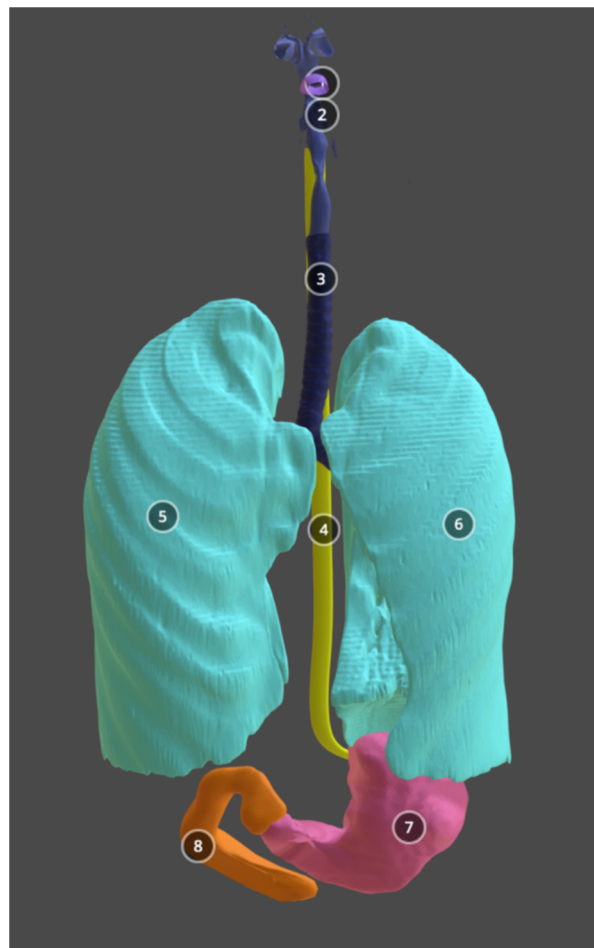
Poster #12 Hannah Benjamin

Interactive Digital Anatomy to Improve Caregiver Understanding in the Aerodigestive Clinic

Capstone Committee: Ernesto Salcedo (chair), Emily DeBoer (mentor), Joel Friedlander, Sparrow Helland

ABSTRACT:

Caregiver understanding is challenging in fast-paced and information-heavy healthcare environments such as pediatric aerodigestive clinics. The aerodigestive clinic encompasses a multidisciplinary team that treats children suffering from complex disorders of the respiratory and digestive systems. Families receive information from 6-8 health care providers regarding aerodigestive procedures, e.g. flexible bronchoscopy, rigid bronchoscopy and upper gastrointestinal endoscopy. The goal of this study was to develop an anatomy-based, interactive digital resource for physician use in clinic to increase caregiver understanding of aerodigestive procedures and how procedure results connect and facilitate child's diagnosis and treatment plan. 3D models of the respiratory and digestive systems were created in ScanIP using de-identified chest CT and MRI enterography. SimLab Composer was used to develop the digital resource, which was then published via SketchFab. Study population was caregivers of children undergoing aerodigestive procedures. Primary outcomes, perceived caregiver understanding and caregiver knowledge, were assessed using a questionnaire at the conclusion of the family's clinic visit. Caregiver understanding was measured on a Likert scale and knowledge was assessed using 5 multiple-choice questions about aerodigestive anatomy and procedures. Mann-Whitney U test was used to compare the medians of primary outcomes for families with and without the resource. Baseline data revealed that only 65% of caregivers report understanding aerodigestive procedures very well. Caregivers scored 70% (median) on questions targeting caregiver knowledge. Caregiver understanding of aerodigestive procedures is limited with the current standard of care. The digital anatomy resource aims to resolve these gaps to ensure adequate consent for procedures, enhance shared decision-making, and improve overall caregiver understanding of aerodigestive diseases and therapies.



Poster #13 Shannon Curran***A Flipped Classroom Design for Circulatory System in Medical School Gross Anatomy: Impact on Student Performance and Attitudes***

Capstone Committee: John Caldwell (chair), Danielle Royer (mentor), Mike Carry

ABSTRACT:

Emphasizing active learning, flipped classroom (FC) strategies promoted deeper understanding and retention. This study aimed to develop a FC curriculum for the circulatory system in medical gross anatomy, determine student attitudes toward this strategy, and evaluate its educational effectiveness. Six circulatory self-study tools were developed, displaying line drawings of typical vessel branching patterns and anastomoses with text pop-ups and prompts for students to draw along. Nine one-hour classroom sessions featured practice blood flow cases and interactive image-based activities focusing on vessel identifications and relationships. First year medical students (N=184) were invited to complete Likert-scale surveys at the end of each of the three units. Response rate ranged from 33.70% to 47.83%. Survey results indicate high approval of the study-tools and the perceived effectiveness of in-class activities. No significant differences were found between unit ratings, indicating high satisfaction across the course. Additionally, theme analysis of comments indicates student support for and satisfaction with the FC. Grades on exam blood flow cases were compared between the 2016 (FC) and 2015 (traditional classroom) cohorts. While a strong trend in increased performance was observed in the FC cohort, only 3 out of 12 items showed a significant increase ($p < 0.05$), which is not enough to conclude that the FC approach leads to superior academic performance compared to the traditional classroom. However, students perceived the circulatory system FC strategy as highly effective for learning, which suggests that this new classroom strategy is a valued addition to medical education.



Poster #15 Johna Iannitto

Assessment of commonly used measures of lower extremity swelling following total knee arthroplasty

Capstone Committee: Danielle Royer (chair), Jennifer Stevens-Lapsley (mentor), Mike Pascoe

ABSTRACT:

Substantial swelling commonly occurs after total knee arthroplasty (TKA); however, a “gold standard” to accurately quantify swelling post-operatively has not been identified. This study was designed with two aims: 1) compare the measurements of change in lower extremity swelling from pre- to post-TKA, obtained via circumferential measurement (CM), bioelectrical impedance spectrometry (BIS), and diagnostic ultrasound (US) 2) correlate each method of swelling measurement to the clinical outcomes of knee range of motion (ROM) and patient reports of pain and 3) conduct an exploratory investigation to attempt to accurately quantify swelling using US by injecting a known amount of saline solution into cadaveric knees.

Swelling measurements from 18 patients undergoing bilateral TKA (36 knees) were collected pre-TKA, two weeks post-, and three months post-TKA. Correlations between the three methods were calculated. ROM was calculated from maximum knee extension and flexion using long arm goniometry. Pain levels were recorded using a ten-point visual analogue scale (VAS). Regression analyses were performed to identify whether CM, BIS, or US were predictive of pain or ROM. For the exploratory component of this study, 50mL of saline was injected into the suprapatellar bursa of three cadavers (5 knees) and volume was measured using US.

Change in BIS and CM were related two weeks post-TKA ($r = -0.331$, $p = 0.048$). No relations emerged between changes in US volumes and BIS or CM. At week two, change in CM was predictive of ROM ($p = 0.049$) and pain ($p = 0.0011$). Changes measured by US and BIS were not predictive of pain and ROM at either time point. The five volumes calculated using US measurements in the exploratory investigation were inconsistent with the actual amount of injected fluid.

Both BIS and CM produced similar measurements when detecting the large increase in swelling two weeks post-TKA. Swelling should be measured by CM as this method is predictive of changes in pain and ROM. Swelling measured using US is not consistent with the other methods. Further work needs to be done to determine the feasibility of using two-dimensional US as a method for quantifying the magnitude of lower extremity swelling. The lack of consistency in measurements obtained using US in the exploratory investigation suggest US may not be a reliable method to accurately quantify swelling volume.



Poster #16 Molika Keeler

The use of a novel Anatomical Mental Rotation Test to enhance understanding of repetitive visual-spatial training on learning outcomes in a human anatomy course

Capstone Committee: Maureen Stabio (chair), Danielle Royer (mentor), Brent Wilson

ABSTRACT:

Visual-spatial (VS) skills can be trained; however, understanding the transfer of VS training to anatomy learning is limited. The study goals were: 1) develop and validate a novel Anatomical Mental Rotation Test (AMRT), 2) use the AMRT to determine how specific criteria impact VS ability, and 3) determine the effectiveness of two novel VS training interventions on anatomy learning. A survey, digital Mental Rotation Test (MRT), and AMRT were developed and distributed to anatomy graduate students and clinicians (N = 69). The AMRT was validated through correlation of each participants' AMRT scores to the well-established MRT. A significant positive correlation ($p < 0.005$) between MRT and AMRT scores demonstrates the concurrent validity of the AMRT. Participant sex, age, work experience, VS learning experiences, and self-perceived VS ability were used to categorize individuals and explain AMRT score differences. Participants who participate in video games, visual arts, or sports scored significantly higher ($p < 0.05$) on the AMRT. Graduate student participants taking an anatomy course (N = 39) were divided into experimental groups (abstract intervention, anatomical intervention, or no VS intervention); intervention groups completed at least 13 daily short VS-training tasks. These participants completed a course examination and a final AMRT. Results indicate no significant correlation between initial AMRT score and exam score, and no significant difference in exam score or final AMRT score across intervention groups. This study validates the novel AMRT as a subject specific cognitive test and broadens understanding of how VS ability and training transfers to anatomy learning.



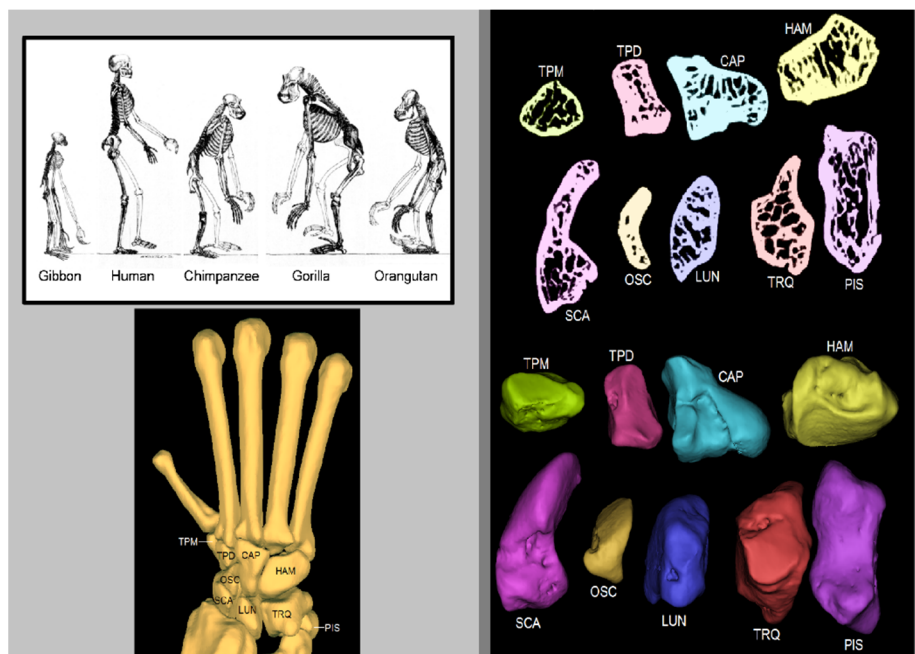
Poster #17 Matthew Mecredy

Estimating Anthropoid Primate Body Mass from Carpal Bone Volume

Capstone Committee: Mike Pascoe (chair), Caley Orr (mentor), Jamie Hodgkins

ABSTRACT:

Estimating body mass is an important tool in evolutionary biology. The purpose of this project was to evaluate the utility of carpal bone volume for estimating anthropoid primate body mass. Using micro-computed tomography and three-dimensional polygon modeling software, the carpal bones of 108 specimens spanning 26 species were analyzed to calculate volume. After separating by sex, 43 volumes for each bone and the complete carpus were regressed against body mass using species means data to evaluate the effectiveness of individual bones and combinations of bones as predictors of body mass. Coefficient of determination (R^2), mean squared error (MSE), Akaike information criterion (AIC), Mallow's C_p , and Bayesian information criterion (BIC) were used to assess the predictors. Capitate volume was estimated to be the best predictor by univariate analysis and multivariate BIC. A two predictor model with capitate and pisiform volume was estimated as best by multivariate AIC. The full model had the lowest overall MSE and Mallow's C_p suggested an 8 parameter model that excluded triquetrum volume. When models included more than two predictors, only intercept and capitate volume coefficient had statistical significance ($P < 0.05$). Species mean body mass was predicted with 6% mean percentage error in a cross-validation sample. Fossil hominoid *Proconsul heseloni* had an average predicted body mass of 12.80 kg – about 3.5 kg greater than estimates using long bone measurements. Paired with imaging and modeling technologies, the carpal bones show strong potential as a skeletal remain that can be used to accurately predict primate body mass.



*Figure: Anthropoid primates include hominoids and old world monkeys. In the images above, the hominoid scaling relationship is depicted along with three-dimensional reconstructions of a *Colobus guereza* carpus from micro-CT images. The *Colobus guereza* is an old world monkey with a body mass similar to the gibbon. The nine carpal bones are labeled as follows: capitate (CAP), hamate (HAM), lunate (LUN), os centrale (OSC), pisiform (PIS), scaphoid (SCA), trapezoid (TPD), trapezium (TPM), triquetrum (TRQ). Note: Primates may have 8 or 9 carpal bones depending on fusion events that can occur between the os centrale and scaphoid.*

Poster #18 Jason Nadeau

Novel 3D Modeling and Measurement of the Left Atrial Appendage to Facilitate Watchman™ Device Implantation

Capstone Committee: Ernesto Salcedo (chair), James Chen (mentor), Lisa Lee

ABSTRACT:

In percutaneous closure of the left atrial appendage (LAA) with the Watchman™ (WM) device, device sizing is traditionally evaluated by two-dimensional (2D) LAA measurements on transesophageal echocardiography (TEE). The objectives of this project were to 1) present novel three-dimensional (3D) modeling of the LAA with non-uniform rational b-spline (NURBS) surfaces based on pre-acquired cardiac computed tomography angiography (CCTA); and 2) to retrospectively compare LAA dimensions between novel 3D measurements from NURBS surfaces and standard 2D measurements from TEE. Thirteen patients with nonvalvular atrial fibrillation (NVAf) underwent LAA closure with the WM device; implantation was successful in twelve cases. The LAA and left heart were isolated from CCTA volumes at atrial end diastole when possible. NURBS surfaces were generated from quadrangular geometry of the LAA, ostial region, and interatrial septum. 3D LAA measurements were made from NURBS surfaces; corresponding 2D measurements were acquired from perioperative TEE. 3D LAA measurements were significantly larger for maximum ostial diameter ($p = 0.0028$, $n = 12$) and significantly smaller for depth ($p = 0.0001$, $n = 10$). Implanted devices were compressed 6.9% beyond the maximum recommended compression. The LAA ostium was significantly more elliptical than the implanted WM device, in both 2D and 3D. Predicted WM sizes from 2D mean and 2D minimum ostial diameters were significantly smaller than the implanted WM. 3D measurement of the LAA from CCTA-derived NURBS surfaces offers a new way to evaluate LAA anatomy. Better awareness of patient-specific LAA dimensions will allow for more personalized planning of LAA closure.

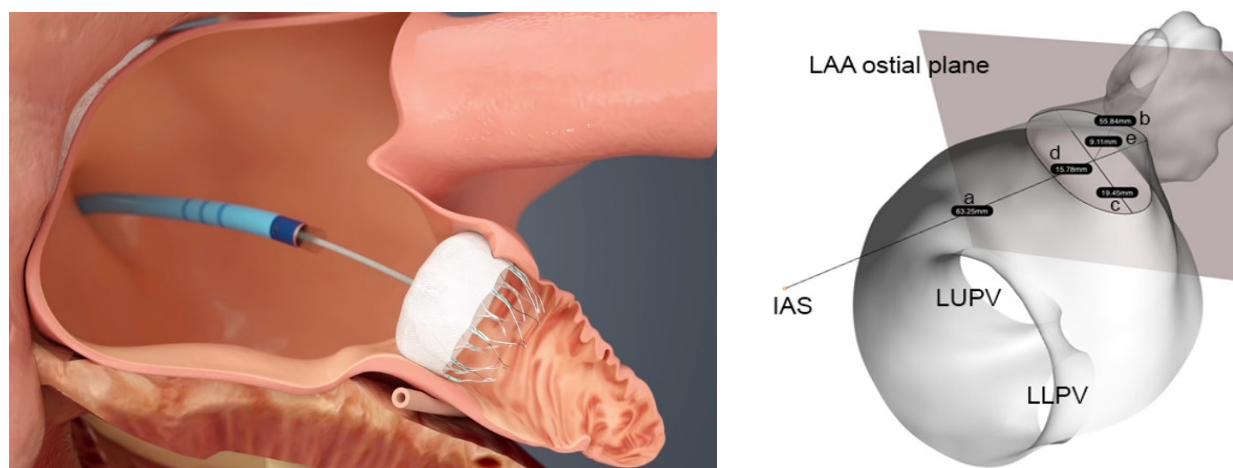


Figure. Left atrial appendage closure with the Watchman™ device can be informed by novel 3D measurements. IAS = interatrial septum, LA = left atrium, LAA = left atrial appendage, LLPV = left lower pulmonary vein, LUPV = left upper pulmonary vein, WM = Watchman™.

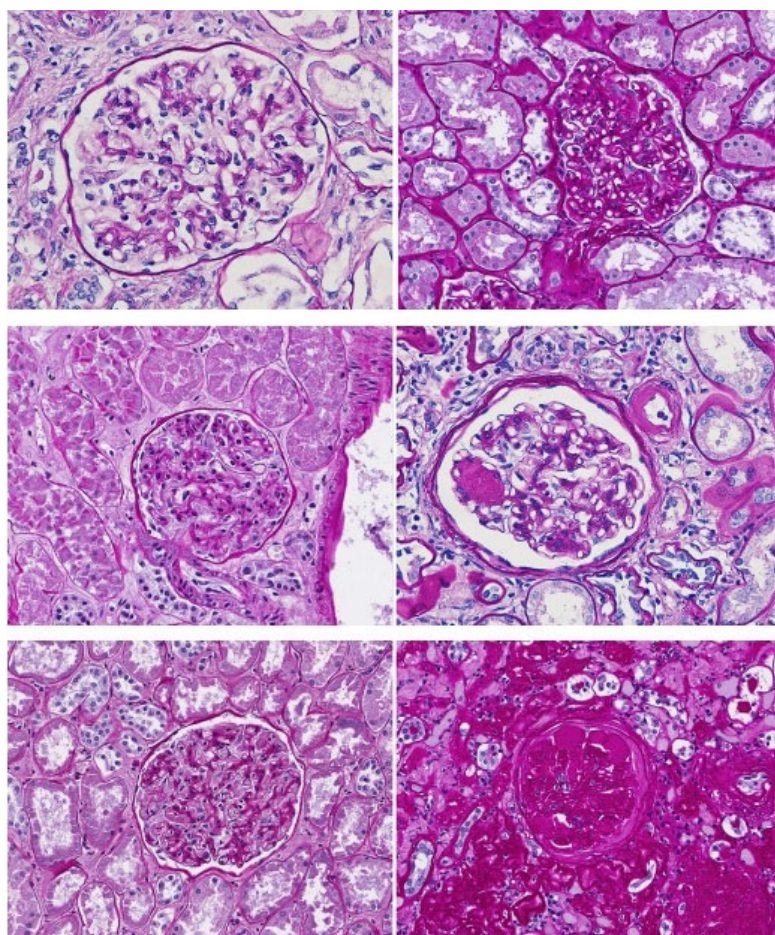
Poster #19 Lucine Papazian

Correlation of Type II Diabetes Mellitus Glomerulopathy with Pancreatic Morphometry

Capstone Committee: Ernesto Salcedo (chair), Lisa Lee (mentor), Zenggang Pan, Francisco LaRosa

ABSTRACT:

Insulin producing beta cells in pancreatic islets play a critical role in the expression and manifestation of type II diabetes. Longstanding hyperglycemia, associated with the diabetic condition, impairs beta cell insulin production and systemic insulin sensitivity. Systemic glycation ensues when insulin production and insulin action are impaired during periods of prolonged hyperglycemia. Microvasculature glycation is central in the pathogenesis of the related diabetic disorder, Diabetic Nephropathy (DN). While DN progression is a documented and staged disorder, DN class I-IV, there is no standard classification for pancreatic morphometric alterations. Pancreatic functional deficits and morphological alterations have been reported, however stages of pancreatic histological changes and correlation with DN pathogenesis remains unestablished. The objective of this study was to investigate the morphometric changes in pancreatic tissue in relation to the established DN progression, and to establish a set of pancreatic histological criteria associated with diabetes progression. In this study, 91 matched pancreatic and kidney tissue slides were obtained from the existing autopsy repository at the University of Colorado Hospital. Pancreatic adipose infiltrates and islet morphology was analyzed and quantified. Matched kidney tissues were then histologically assessed and grouped, DN class I-IV. The quantified pancreatic metrics were compared across the four DN groups. The results show a marked increase in adipose infiltration and a decrease in islet density in the pancreas corresponding with DN class I at onset, and a significant reduction in total pancreatic islet composition throughout DN. For the first time, coinciding diabetic complications between the organ systems has been evaluated, and DN progression has been correlated with pancreatic morphometry.



Poster #20 Alejandro Sigala

3D Analysis of the Human Aortic Root to Guide Transcatheter Aortic Valve Replacement with SAPIEN™ and Evolut™ R Devices

Capstone Committee: Norma Wagoner (chair), James Chen (mentor), Ernesto Salcedo

ABSTRACT:

Transcatheter aortic valve replacement (TAVR) serves as a treatment option for individuals with severe aortic stenosis. Traditionally, valve device sizing is determined by two-dimensional (2D) aortic root measurements on cardiac computed tomography angiography (CCTA) volumes. The objectives of this study were to 1) create novel three-dimensional (3D) models and measurements of the aortic root from CCTA; and 2) to retrospectively compare aortic root measurements between novel 3D models and standard preoperative 2D measurements. Eleven (11) patients with a history of severe aortic stenosis received either a SAPIEN™ 3 or Evolut™ R prosthetic valve. The aortic root was isolated from CCTA volumes at ventricular end-systole and end-diastole. 3D low-density quadrangular mesh models were created for each patient from which the contours of the left ventricular outflow tract (LVOFT), annulus, sinus of valsalva, sinotubular junction (STJ), and proximal aorta were isolated for 3D analysis. The ostium of the left and right coronary arteries and semilunar attachment points also underwent 3D analysis. 3D measurement is an innovative method for evaluating aortic root anatomy. Improved anatomical evaluations will provide effective information for patient-specific TAVR procedures.

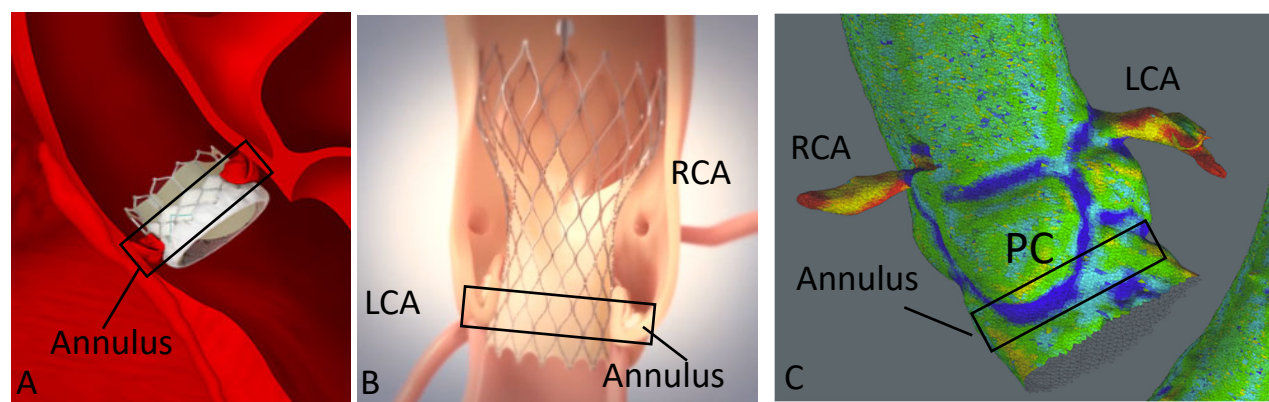


Figure: Aortic root anatomy information from novel 3D measurements can guide TAVR with the SAPIEN™ 3 (A) and Evolut™ R (B) prosthetic valves. LCA = left coronary artery, RCA = right coronary artery, PC = posterior semilunar cusp.

Poster #21 Hermella Yilma

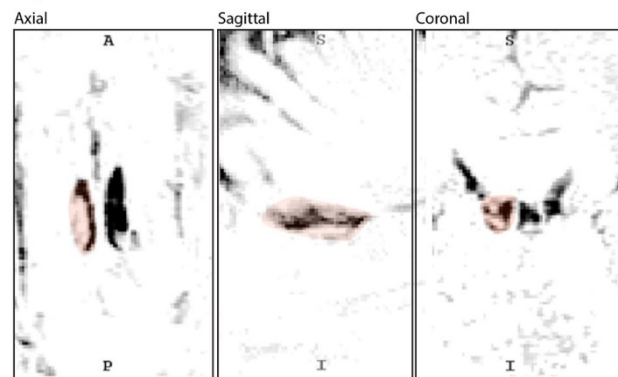
Structural changes associated with duration of subthalamic nucleus deep brain stimulation in patients with Parkinson's disease with a focus on olfactory processing

Capstone Committee: John Caldwell (chair), John Thompson (mentor), Ernesto Salcedo, Nicole Garneau

ABSTRACT:

Olfactory loss is a well-known prodromal marker in patients with Parkinson's disease, but less understood is how olfactory loss is also a symptom of this neurodegenerative disease. Previous work has shown that olfactory processing is highly plastic and can recover following loss of function. In humans, studies indicate that change in olfactory bulb volume may parallel change in olfactory function, both loss and gain in function. Therefore, interventions that impact olfactory function, even indirectly, may help address olfactory loss in PD patients. Currently, olfactory loss in Parkinson's disease remains untreated; however, studies have shown that deep brain stimulation of the subthalamic nucleus, a treatment for advanced Parkinson's disease, can improve olfactory function. However, the relationship between subthalamic nucleus stimulation and olfactory function has not been examined in this context before. In this study, we sought to test whether patients with Parkinson's disease that have undergone longer periods of subthalamic nucleus stimulation will exhibit greater change in olfactory bulb volume, as well as changes in brain areas associated with olfactory processing including the following: the thalamus, hippocampus and lateral orbitofrontal cortex. We studied three groups of patients with different time periods of subthalamic nucleus stimulation: short (0-55 days), medium (55-306 days), and long periods (>306 days). In addition to the Parkinson's disease subjects, we included as a control group, a second movement disorder population treated with deep brain stimulation but not known to be associated with olfactory deficits: Essential Tremor. Our results show a significant increase in olfactory bulb volume with length of stimulation. Furthermore, there are positive trends in plasticity within cortical structures associated with olfactory processing in the longer stimulation group. These results are the first to suggest a possible anatomical mechanism for olfactory improvements observed following subthalamic nucleus deep brain stimulation in Parkinson's disease.

Olfactory bulb identification



Estimate of cortical thickness post-DBS implant

