Modern Human Anatomy Program

UNIVERSITY OF COLORADO
ANSCHUTZ MEDICAL CAMPUS

2018

Capstone Project Poster Presentations

Tuesday, April 17th

Education 2 Bridge

2018 Modern Human Anatomy Program
Capstone Poster Presentations
Agenda

April 17, 2018

8:30 AM – 9:00 AM	Breakfast available, students arrive
9:00 AM	Welcome and overview, Dr. John Thompson
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

Session I Poster Presenters
9:00 AM – 10:30 AM

Capstone Poster Presenter	Poster #	Abstract Page #	Poster Title	Category
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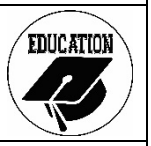
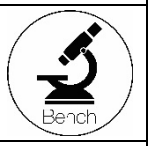
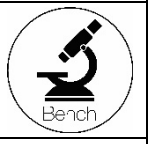
Cory Buenting	**2**	6	One Does Not Simply Integrate: Assessing Integrated vs. "Silo-ed" Anatomical Sciences Presentation in Online Learning Module	
Andrew Cale	**3**	7	Gross Anatomy Review Course for Anesthesiology Residents on the Acute Pain Service: How Basic Science Training Can Improve Knowledge and Confidence	
Angelique Dueñas	**4**	8	Assessing 3D Learning Resource Preference and Performance in Embryology Education	
Elizabeth Eichinger	**5**	9	What's the Matter?: A Longitudinal Look at Multiple Sclerosis-Related Total Brain vs Structure Atrophy and Cognitive Performance	
Nicholas Evans	**6**	10	Bridging the Gap: Integrating a virtual, 3D model with Finite Element Analysis to examine fixed dental prosthesis materials under combined loading	
Shilpi Ganguly	**7**	11	Characterization of P. Aeruginosa Growth Patterns Under Varying Gravitational Regimes	
K. Chase Lewis	**8**	12	Objective Assessment of Dental Anatomy Using Surface Scanning Technology and 3D Image Analysis	
Mayu Oya	**9**	13	Analysis of Dendritic Spine Density in Hippocampus Following Cardiac Arrest	
Ian Stewart	**10**	14	Development and Incorporation of Virtual Pathology Slides with Instructor Simulation Tools in Pathology Residency Training and Histology Education	

Session II Poster Presenters
10:30 AM – 12:00 PM

Capstone Poster Presenter	Poster #	Abstract Page #	Poster Title	Category
Rossana Blanco Prado	**11**	15	Use of systematic stimulation mapping and functional/structural imaging to improve localization of seizure onset in patients with drug-resistant epilepsy	
Dane Donegan	**12**	16	Neuromodulation of motor learning and performance mediated by optogenetic stimulation of the basal forebrain	
Jacob Feiler	**13**	17	An fMRI Study Examining Inhibition and Threat Vigilance Among Adolescents with Severe Worry	
Daniel Heck	**14**	18	The organization of synaptically convergent Purkinje cells to distinct postsynaptic cell types in the mouse cerebellum	
Hannah Koury	**15**	19	"I Have a Tear Down There?": Implementing a Three-dimensional Anatomical Education Resource into Post-partum Perineal Laceration Care	
Guttu Maskalo	**16**	20	The relationship between radial optic flow perception and neurodegeneration in Parkinson's Disease: A volumetric MRI analysis	
Daniel Uy	**17**	21	Inter-hemispheric analysis of compensatory neural activity and volumetric changes in deep brain stimulation patients	
Carissa Vinovskis	**18**	22	Prevalence of Adrenal Incidentalomas and Assessment of Practitioner Follow Up Per Guidelines	

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
Blanco Prado, Rossana	**John Caldwell**	**John Thompson**	**Cornelia Drees**
Blaskowsky, Justin	**Norma Wagoner**	**Tobias Eckle**	**Ernesto Salcedo**
Buenting, Cory	**Lisa Lee**	**Caley Orr**	**Janet Corral**
Cale, Andrew	**Maureen Stabio**	**Danielle Royer**	**Matthew Lyman**
Donegan, Dane	**John Thompson**	**Cristin Welle**	**Ethan Hughes**
Dueñas, Angelique	**Ernesto Salcedo**	**Lisa Lee**	**Jennifer Stratford**
Eichinger, Elizabeth	**Ernesto Salcedo**	**Enrique Alvarez**	**John Thompson**
Evans, Nicholas	**Caley Orr**	**Thomas Greany**	**John Caldwell**
Feiler, Jacob	**Maureen Stabio**	**Benjamin Mullin**	**John Thompson**
Ganguly, Shilpi	**Ernesto Salcedo**	**Luis Zea**	**Thomas Finger**
Heck, Daniel	**John Caldwell**	**Abigail Person**	**Sawako Fukushima**
Koury, Hannah	**Lisa Lee**	**Janet Corral**	**Tyler Muffly**
Lewis, K. Chase	**Caley Orr**	**Thomas Greany**	**Clifford Litvak**
Maskalo, Guttu	**John Thompson**	**Victoria Pelak**	**Norma Wagoner**
Oya, Mayu	**Maureen Stabio**	**Nidia Quillinan**	**Thomas Finger**
Stewart, Ian	**Ernesto Salcedo**	**Lisa Lee**	**Brian Moore**
Uy, Daniel	**John Caldwell**	**John Thompson**	**Aviva Abosch**
Vinovskis, Carissa	**Ernesto Salcedo**	**Lauren Fishbein**	**Margaret Wierman**

Session I: 9:00 AM – 10:30 AM

Poster #1 Justin Blaskowsky

Bench

A Comparison of Esmolol, Epinephrine, and the Combination of Both in Reperfusion Injury After Murine Myocardial Ischemia

Capstone Committee: Norma Wagoner (chair), Tobias Eckle (mentor), Ernesto Salcedo

ABSTRACT:

In patients who have suffered from myocardial ischemia after cardiac arrest or myocardial infarction, subsequent reperfusion injury, caused by the reintroduction of oxygen to cardiac tissue, has been found to be a major contributing factor to increased morbidity and mortality. (Hausenloy et al., 2017) The aim of this study is to provide evidence of the possible cardioprotective effects, based on infarct size and troponin I level, that esmolol may have against reperfusion injury after myocardial ischemia, in a murine model. Esmolol's effect on infarct size was compared to a saline control, epinephrine, and a combination of esmolol and epinephrine.

To test this, a total of 25 6-month-old C56/BL6 mice were randomly divided into four test groups: 6 saline, 7 esmolol, 6 epinephrine, and 6 esmolol combined with epinephrine. Each group was subjected to ischemia of the left ventricle via occlusion of the left coronary artery by way of the hanging weight system developed by (Eckle et al., 2011). Each group received the respective drug and the hearts were excised, stained, and photographed for infarct area analysis.

Results indicate a statistically significant reduction in infarct size in the esmolol group when compared to saline (0.24 of area at risk (AAR) ± 0.09 esmolol vs. 0.41 of AAR ± 0.04 saline). A statistically significant reduction in Troponin I (cTnI) level was also detected in the esmolol group when compared to the saline group (33.19 ng/ml ± 19.37 esmolol vs. 76.10 ng/ml ± 28.10 saline). There was no significant reduction in infarct size or cTnI level between the other testing groups.

These results support the hypothesis that esmolol has the ability to reduce myocardial damage resulting from reperfusion injury. Epinephrine was included in the study because it is a current method of treatment for post-infarct patients with severe hypotension and has been shown in other studies to increase myocardial disfunction after ischemia (Tang et al., 1995). The evidence provided here may lay the groundwork for future studies to further investigate the potential beneficial effects of esmolol administration post-myocardial ischemia.

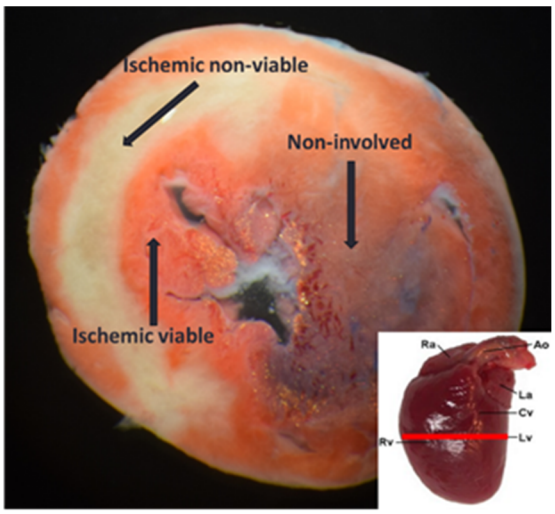


Figure 1 – An example of left ventricular myocardial ischemic tissue after administration of epinephrine. Ischemic tissue is white, red is ischemic but viable, and blue is non-involved tissue. Whole heart photo credit (Morawietz G, 2004)

Poster #2 Cory Buenting

One Does Not Simply Integrate: Assessing Integrated vs. "Silo-ed" Anatomical Sciences Presentation in Online Learning Module

Capstone Committee: Lisa Lee (chair), Caley Orr (mentor), Janet Corral

ABSTRACT:

Anatomical sciences are fundamental medical competency; however, classroom contact hours are minimal due to nation-wide, integration-driven curricular reform, which correlates with increased adjunct online learning resources. Such resources vary in content, format, and accuracy, for there are few evidence-based guidelines for developing effective resources that yield measurable learning. Thus, the objective was assessing the educational value of two types of online module presentations: integrated vs. “silo-ed” presentation of the peritoneum.

The two versions of online learning modules contained identical embryology, histology, and gross anatomy content and interactive features. The control module presented the subjects sequentially, and the experimental module integrated all three subjects for each organ. First-year graduate and health professional students were recruited and randomly assigned to access either module. Participants completed a prequiz and after module interaction, a postquiz/survey.

Analysis of prequiz vs. postquiz scores from 133 participants revealed a significant increase in postquiz performance in both control and experimental groups. However, the amount of postquiz increase between groups was not statistically significant. Survey analyses revealed that more experimental group participants reported enhanced understanding of gross anatomy and embryology of the peritoneum after module use, compared to the control group. This may suggest students’ slight preference for the integrated presentation of some anatomy subjects. This study highlights the educational value of online learning resources for anatomical sciences which, regardless of integration, can yield measurable learning outcomes. However, student perceptions and module preference have implications for resource development, motivation studies, and instructor or course evaluations.

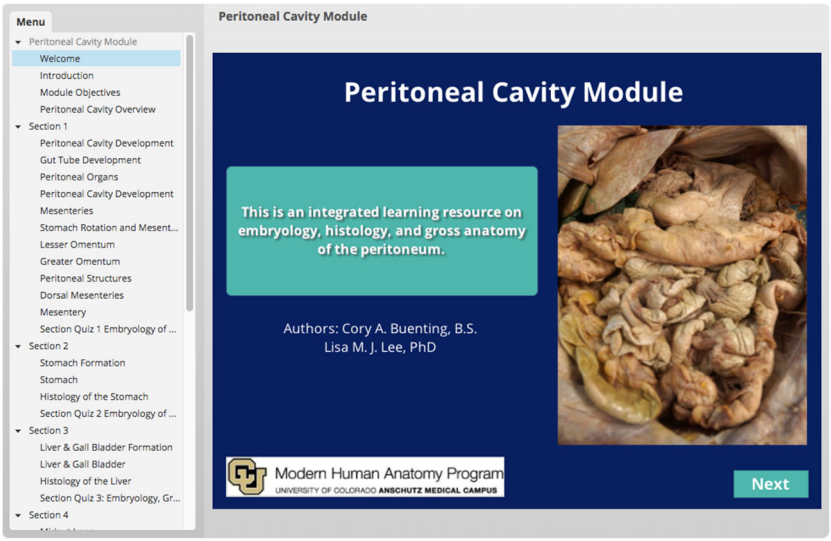


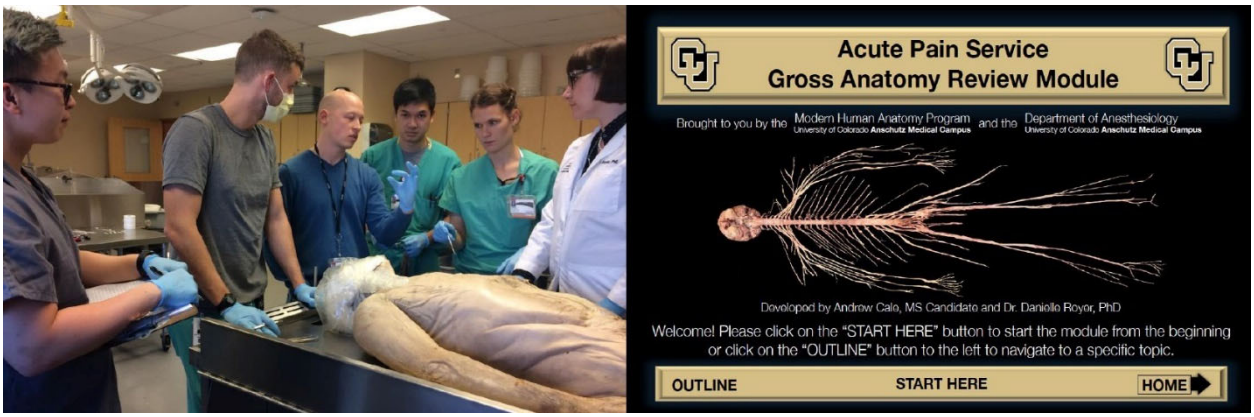
Figure: Introductory image for both the integrated and "silo-ed" Peritoneal Cavity Modules created for this study.

Poster #3 Andrew Cale

Gross Anatomy Review Course for Anesthesiology Residents on the Acute Pain Service: How Basic Science Training Can Improve Knowledge and Confidence

Capstone Committee: Maureen Stabio (chair), Danielle Royer (mentor), Matthew Lyman

ABSTRACT:
The Anesthesiology Acute Pain Service (APS) manages peri-operative pain using ultrasound-guided peripheral nerve blocks (PNB). PNB success is dependent on detailed anatomical knowledge, which residents may not have formally reviewed in years. This study describes and evaluates novel strategies for improving residency education using adjuncts that provide anatomical context to APS residents. The Cadaver Review Session was developed to reintroduce the anatomy relevant to the most common PNBs on the APS. In each Review, an anatomist reviewed the major nerves, while an APS attending integrated the anatomy with PNB methods and cases. A digital Module was also built to review the same anatomy content as the Review via quizzes, clinical cases, and highlight-to-reveal style pop-ups. An IRB-exempt survey was distributed post-Review to all participants (March – November 2017, N = 27). Likert responses (5 = strongly agree) were analyzed to evaluate the impact of the Review on the residents' confidence with anatomy (7 items) and perceptions (4 items). For a subgroup of residents in the Review group (N = 18) and all the residents in the Module group (n=7), change in pre-/post-test ratings were compared. Residents reported significant ($p<0.05$) improvements to their confidence in their anatomical knowledge and in their ability to identify anatomical structures on different media. However, anatomical knowledge did not change between pre- and post-intervention. Belief that the Review and Module would improve future board exam and clinical performance also increased, although not significantly. Residents also found the adjuncts to be accessible and would highly recommend them.



Poster #4 Angelique Dueñas

Assessing 3D Learning Resource Preference and Performance in Embryology Education

Capstone Committee: Ernesto Salcedo (chair), Lisa Lee (mentor), Jennifer Stratford

ABSTRACT:
The purpose of this study was to assess whether 3D virtual and printed models yield a greater learning outcome, and determine student preference for such resources. Embryology, the study of embryonic development, is one of the fundamental anatomical sciences, mastery of which aids in understanding gross anatomy and congenital abnormalities. Unfortunately, embryology is perhaps one of the most challenging subjects to teach and learn, due to the complex 4-dimensional (4D) nature of morphogenesis, which is exacerbated by lack of effective visual resources. With advents in technology in imaging and 3D printing in the recent years, more 3D figures and virtual embryo models are beginning to emerge. However, the quality and accuracy of the resources vary and whether these resources are effective in teaching and learning embryology is yet to be formerly assessed. Thus, in this study, first year students enrolled in anatomical sciences courses in medical, dental and graduate programs were recruited to assess educational values of different types of embryology resources. Recruits were randomized into three groups, each receiving one of three embryonic learning objects; pamphlet with embryo images, pamphlet with either 3D virtual embryo model, or a 3D printed embryo model. Educational value of these resources was assessed by pre-quiz vs post-quiz performance comparison across the experimental groups. Survey was performed to assess students' preference and perceived value of different resources. The results indicate that exposure to the interactive learning resources (virtual and printed models), in the absence of formal lecture, leads to a measurable learning outcome. Further, students highly rated the interactive resources, especially the virtual model, and support the production of more resources to support embryology education.

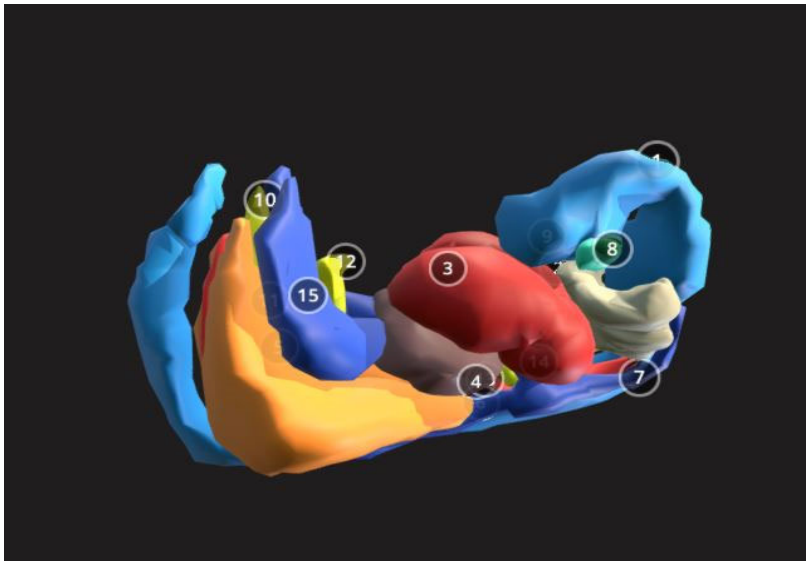


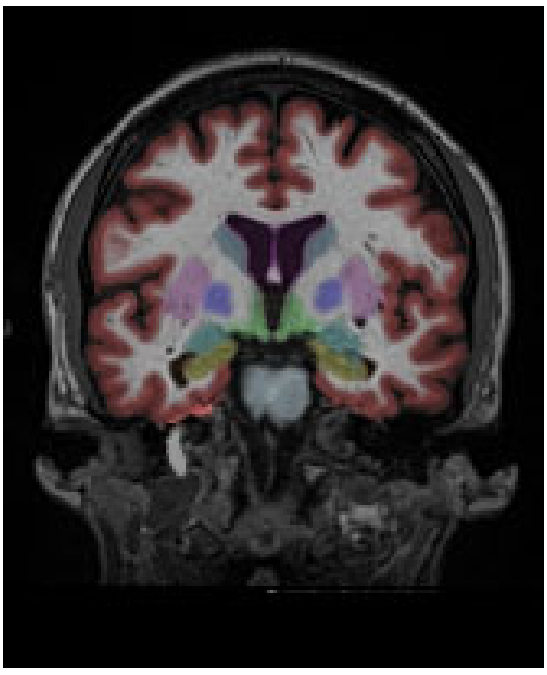
Figure: Image of new virtual model, displaying organs at the 6th week of development.

Poster #5 Elizabeth Eichinger

What's the Matter?: A Longitudinal Look at Multiple Sclerosis-Related Total Brain vs Structure Atrophy and Cognitive Performance

Capstone Committee: Ernesto Salcedo (chair), Enrique Alvarez (mentor), John Thompson

ABSTRACT:
Multiple sclerosis (MS) is a disease of atrophy where the immune system attacks the myelin sheath of neurons in the central nervous system. While 2.5 million individuals grapple with MS worldwide, research of the long-term effects of MS on brain volume remains sparse. Current cross-sectional studies of patients with MS have determined that volume loss is frequently associated with deep gray matter structure, indicating that thalamic volume loss is highly common and correlated with a decrease in processing speed. Conversely, cross-sectional studies of patients receiving disease modifying therapy (DMT) have illuminated the benefits of treatment on maintaining brain volume. In this study, we chose to take a longitudinal approach to investigate the effects of DMT on MS patient fractionated verses whole brain volume and cognitive testing scores over the course of two years. Through the use of NeuroQuant auto-segmentation software, T1 MPRAGE scans from baseline and year two were segmented and structure volume was calculated. Additionally, cognitive function was assessed using the Minimal Assessment of Cognitive Function in MS (MACFIMS) at baseline and year two. Patients receiving DMT Copaxone and Gilenya showed no significant atrophy over the course of the study. Interestingly, MACFIMS scores increased with time. The effects of DMT on MS from a longitudinal perspective remains consistent with the literature on cross-sectional studies. The efficacy of MACFIMS to repeatedly assess cognitive function in MS patients should be investigated further to get a clearer understanding of the effects of exposure and experience on test score.

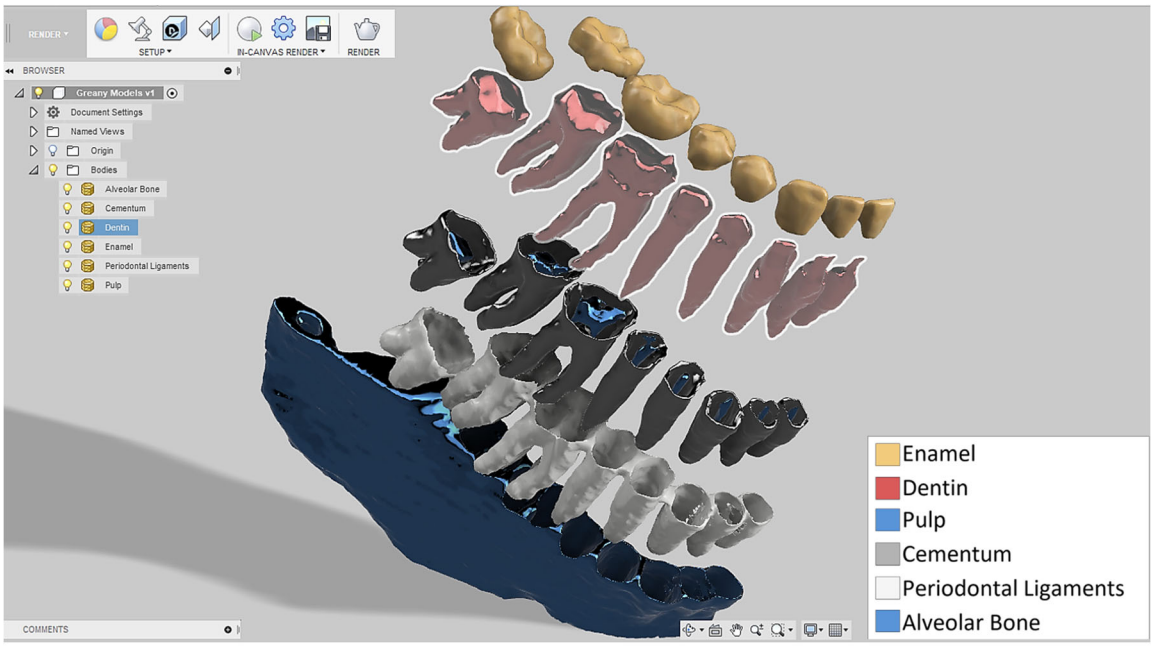


Poster #6 Nicholas Evans

Bridging the Gap: Integrating a virtual, 3D model with Finite Element Analysis to examine fixed dental prosthesis materials under combined loading

Capstone Committee: Caley Orr (chair), Thomas Greany (mentor), John Caldwell

ABSTRACT:
Dental crowns and three-unit fixed prostheses ("bridges") are constructed to be durable and aesthetically pleasing. A multitude of different materials are developed to pursue the optimal blend of these features. Layered ceramic is a traditional dental material utilized because of the seamless visual transition between ceramic and enamel and the resistance to fracture by compression forces. Monolithic zirconia is an innovative material developed because of high biocompatibility with human dentition. Both these materials provide satisfactory clinical results; however, the methods used to predict the durability of the dental materials have not been optimized. Models of the stomatognathic system depict alveolar bone as rigid concrete, and other tooth layers, such as dentin and periodontal ligaments, are inaccurately assumed to have little or no movement. Additionally, combined loading scenarios (produced by compression, tension, torsion and internal shear stress) of functional or parafunctional chewing behaviors induce complex stress patterns within dental prostheses that have yet to be well documented. Therefore, I created a three-dimensional model of a mandibular quadrant by assigning material properties to each tooth layer, thereby assembling a malleable model that accurately responds to applied force by flexing. In this investigation, I used finite element analysis to examine failure modalities between traditional layered ceramic and monolithic zirconia under combined loading by utilizing a virtual, layered model of human dentition. This novel analysis may lead to improvements in future dental prostheses and designs.

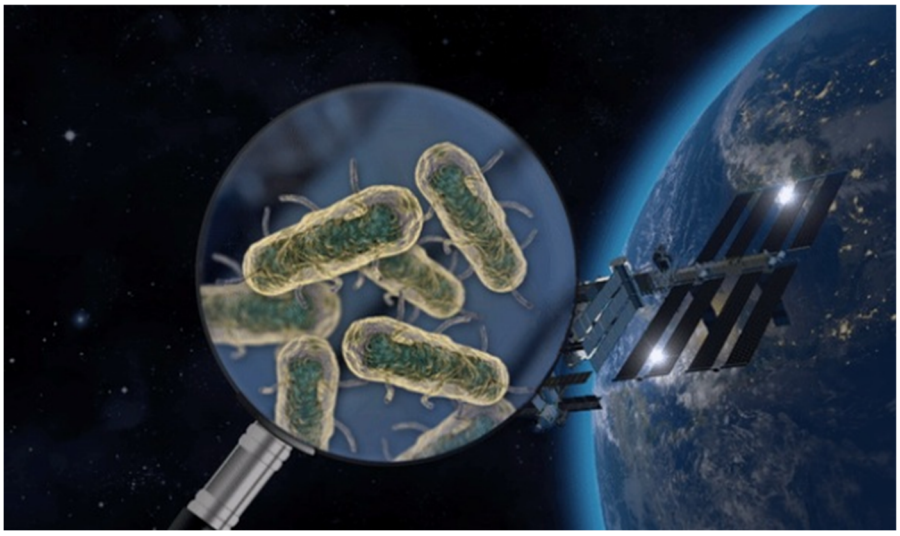


Poster #7 Shilpi Ganguly

Characterization of P. Aeruginosa Growth Patterns Under Varying Gravitational Regimes

Capstone Committee: Ernesto Salcedo (chair), Luis Zea (mentor), Thomas Finger

ABSTRACT:
Human presence in space will always come with the risk of pathogenesis. Furthermore, numerous studies have shown that spaceflight results in the suppression of immune responses in crew members. Since P. aeruginosa is known to cause serious life-threatening infections in immunocompromised persons, it remains vital to understand how gravity alters P. aeruginosa in order to combat this pathogen more effectively. The overall goal of this project aims to determine whether Pseudomonas aeruginosa demonstrates altered growth patterns when exposed to varying gravitational regimes. To test this research question, pre-determined amounts of P. aeruginosa were injected into BioServe's 12-well BioCells, with 8 of the 12 wells loaded with sterilized silicone coupons, a commonly used substrate in both spaceflight and hospital environments. Prepared BioCells were placed on a clinostat to simulate varying gravitational regimes and cultured for a 1-week period. Planktonic P. aeruginosa samples were analyzed over time to determine the effects of gravity on bacterial cell proliferation. P. aeruginosa biofilm samples grown on silicone were analyzed to determine the effects of gravity on biofilm morphology. It was found that as gravity decreased, planktonic P. aeruginosa began to proliferate with significantly greater cell counts and biomass values beginning approximately 54 hours post inoculation. Final cell counts and mass values were significantly varied between all 4 gravitational regimes, with microgravity demonstrating the greatest cell counts and biomass. P. aeruginosa biofilms demonstrated significantly increased mean thickness, biomass, and substratum coverage along with significantly decreased roughness coefficients with decreasing gravitational regime. Having identified that the absence of gravity plays a positive role in the proliferation of planktonic P. aeruginosa and the formation of biofilms, there now exists further need in exploring whether any of these identified changes play a role in bacterial pathogenesis and virulence. A greater understanding of the phenotypic and genotypic markers which are associated with bacterial pathogenesis and resistance will allow for the more targeted production of treatment modalities. It is imperative we understand the effects of these changes on human health and work towards developing the appropriate tools necessary to combat the formation of these biofilms if we ever hope to make our dreams of interplanetary travel and extraterrestrial colonization a reality.

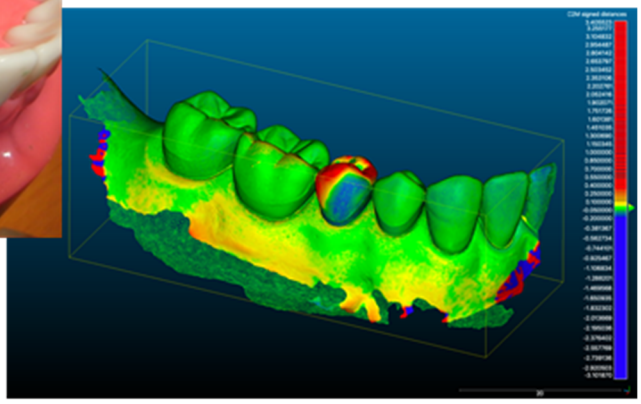


Poster #8 K. Chase Lewis

Objective Assessment of Dental Anatomy Using Surface Scanning Technology and 3D Image Analysis

Capstone Committee: Caley Orr (chair), Thomas Greany (mentor), Clifford Litvak

ABSTRACT:
Dental school students learn dental anatomy and morphology by making teeth out of wax to match natural human dentition on plastic typodonts. Trained dental school faculty traditionally grade student wax-up projects using visual inspection and a specific rubric of anatomic structures. Several studies have documented low inter-rater and intra-rater reliability for the traditional visual inspection method. Thus, many consider visual inspection to be subjective. The goal of this study was to design a modern protocol for virtual evaluation and objective grading of student dental anatomy projects. This study tested the hypothesis that virtual evaluation of wax-ups using surface scanning technology and 3D image analysis provides more accurate and precise grading than visual inspection. The approach employed a novel technique for digital grading using open source CloudCompare software. Student wax-up projects were graded both visually and virtually. The grading results were statistically analyzed for intra-rater and inter-rater reliability as proxies for precision and accuracy respectively. Visual inspection demonstrated significantly low precision. Virtual evaluation proved to be more accurate than visual inspection when comparing intraclass correlation coefficients. The results provide a compelling assertion to use virtual evaluation in future dental anatomy courses. This modern technique will facilitate student self-assessment, enhanced teaching tools for faculty, and an improved protocol for grading dental anatomy projects.

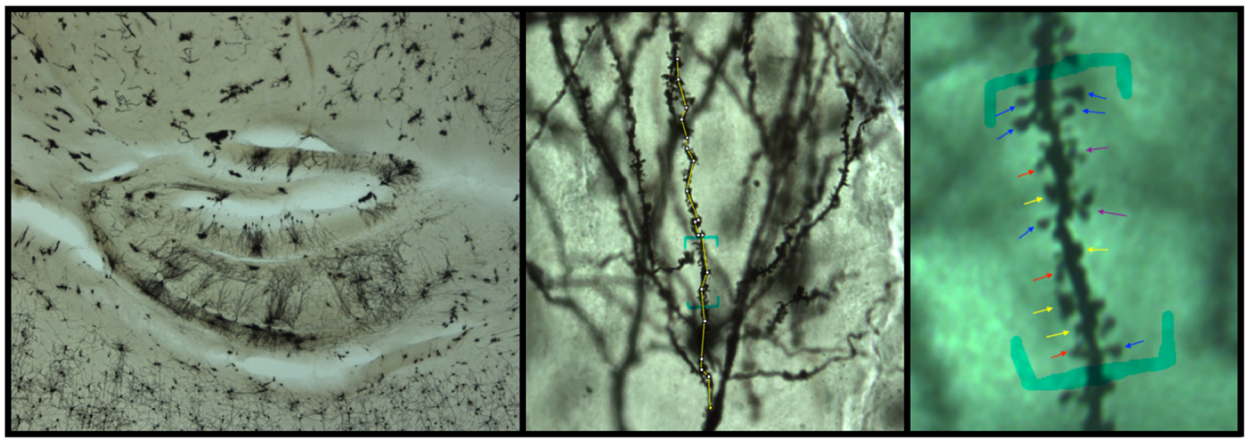


Poster #9 Mayu Oya

Analysis of Dendritic Spine Density in Hippocampus Following Cardiac Arrest

Capstone Committee: Maureen Stabio (chair), Nidia Quillinan (mentor), Thomas Finger

ABSTRACT:
Cardiac arrest (CA) occurs when the electrical system of the heart malfunctions, leading to insufficient blood flow to the brain, termed cerebral ischemia. CA1 neurons of the hippocampus are particularly sensitive to ischemia, contributing to memory deficits after cardiac arrest. Previous work has demonstrated that at acute time periods (two to three days) after cardiac arrest and cardiopulmonary resuscitation (CA/CPR), there is dendritic plasticity. However, little is known regarding dendritic and spine morphology at longer time periods after CA/CPR. This study investigated the structural plasticity of the CA1 neurons, dendrites, and spines in mice after CA/CPR. Adult CA/CPR mice models were divided into four groups: sham, one (24 hours), seven, and 30 days after CA/CPR. The brains were stained with Golgi-cox, sagittally sectioned, and analyzed using ImageJ. The dendrites and their spines were observed in the CA1 region, and spine density, primary dendrite width, soma length, soma width, and soma area were calculated. Spines were also assigned a morphological classification that ranges from immature to mature spines. Our data shows that there was a significant reduction in spine densities at each time point after CA compared to the sham. Furthermore, spine classification shows that CA caused a shift towards more immature spine morphology at 24 hours and 7 days after CA/CPR but shifted towards more mature spine morphology at 30 days after CA/CPR. These data demonstrate that there is structural plasticity at longer time periods after CA/CPR. These changes likely correlate with synaptic plasticity impairments in the hippocampus.

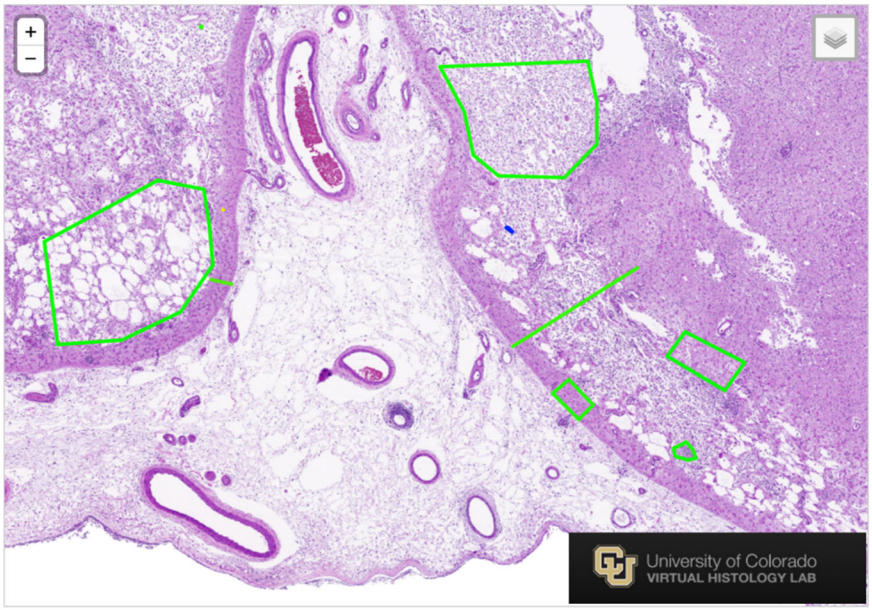


Poster #10 Ian Stewart

Development and Incorporation of Virtual Pathology Slides with Instructor Simulation Tools in Pathology Residency Training and Histology Education

Capstone Committee: Ernesto Salcedo (chair), Lisa Lee (mentor), Brian Moore

ABSTRACT:
Curricular trends minimizing basic sciences contact hours drive virtual microscopy's (VM) replacement of optical microscopy (OM) in undergraduate medical education (UME) for histology. Simultaneously, clinical contextualization is increasing, and few VM collections feature integrated normal and pathological cases. VM's educational value is well established in UME, however, visual literacy acquisition still requires instructional encounters with experts. Additionally, little literature examines VM usage and value in graduate medical education (GME), possibly due to training modality discontinuity between UME and GME, where OM predominates in pathology residency. Recent FDA approval of a whole-slide imaging (WSI) system for routine diagnostics foreshadows more widespread VM use in GME. Thus, this project examines the educational value of incorporating VM with instructor simulation tools (IST) in pathology residency; and integrating clinical VM content in normal histology education. A neuropathological glass tissue slide collection was digitized using WSI, then the files were processed for access via a custom web-based VM app with IST. IST included annotations highlighting characteristic histopathological features, and timed quizzes with an immediate feedback system, mimicking the question-and-answer driven interactions between experts and trainees. Pathology residents and anatomy graduate students were given access to the VM with IST. Pre-test/post-test comparison before and after VM exposure revealed users' content knowledge increased following VM exposure. A post-test survey gauged users' perceived value of the VM slides. Preliminary resident data suggest positive effects of VM in GME, consistent with positive impacts reported in UME. Clinical VM exposure positively affected graduate students' interest and motivation for learning histology.



Session II: 10:30 AM – 12:00 PM

Poster #11 Rossana Blanco Prado

Use of systematic stimulation mapping and functional/structural imaging to improve localization of seizure onset in patients with drug-resistant epilepsy

Capstone Committee: John Caldwell (chair), John Thompson (mentor), Cornelia Drees

ABSTRACT:
Stereotactic Electrode Encephalography (SEEG) and intracranial monitoring are common practice utilized to demarcate epileptic onset zones in patients with drug-resistant epilepsy. The objective of this study is to use patient-specific cortical and subcortical segmentations from structural MRI to assess the likelihood that SEEG electrodes (using postoperative CT images) are implanted in a common set of cortical areas across subjects. We assessed the association between cortical electrode location, and stimulation-induced clinical symptoms during intracranial monitoring in 10 patients with drug-refractory epilepsy. We hypothesized that stimulation-induced symptoms would correlate with distinct cortical brain areas (both gray and white matter). We used a novel analysis pipeline based on a recently published method (MATLAB iElvis toolbox) and Freesurfer to prepare pre-electrode implantation patient MRI and post-implantation CT scans to build a three-dimensional model, corrected for brain shift. Electrodes were mapped in 3D-space in BioImage Suite Electrode Editor software. Cortical brain areas were identified in Freesurfer and merged with patient-specific, BioImage-generated 3D-model of the SEEG electrodes. Data were analyzed for stimulation mapping results and correlation of electrode cortical location across patients. We found that clinical symptoms were localized to corresponding cortical areas during stimulation mapping of patients undergoing Phase II intracranial monitoring. We also found that SEEG electrodes were most commonly implanted across patients in the left hemisphere, specifically in the frontal and temporal lobes. These findings support our hypotheses that stimulation mapping elicits clinical symptoms closely associated with a cortical area, and there is a common set of cortical brain areas that are identified for SEEG and intracranial monitoring.

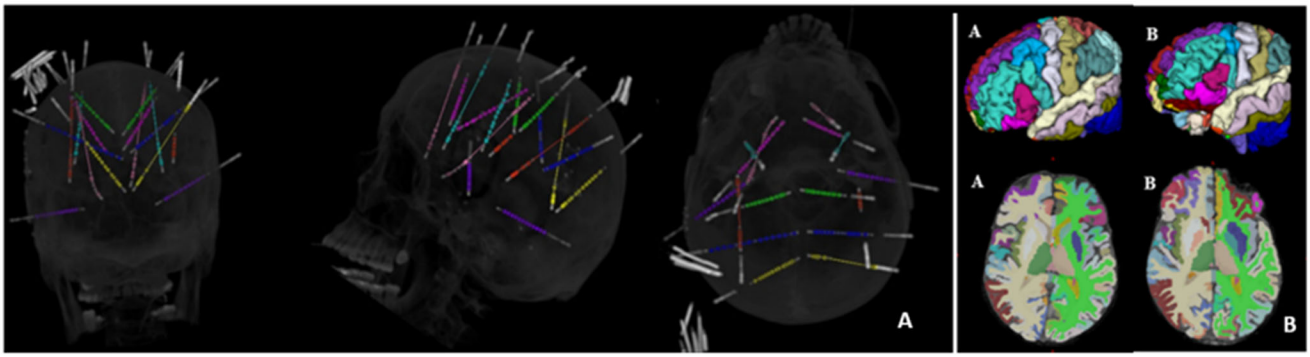


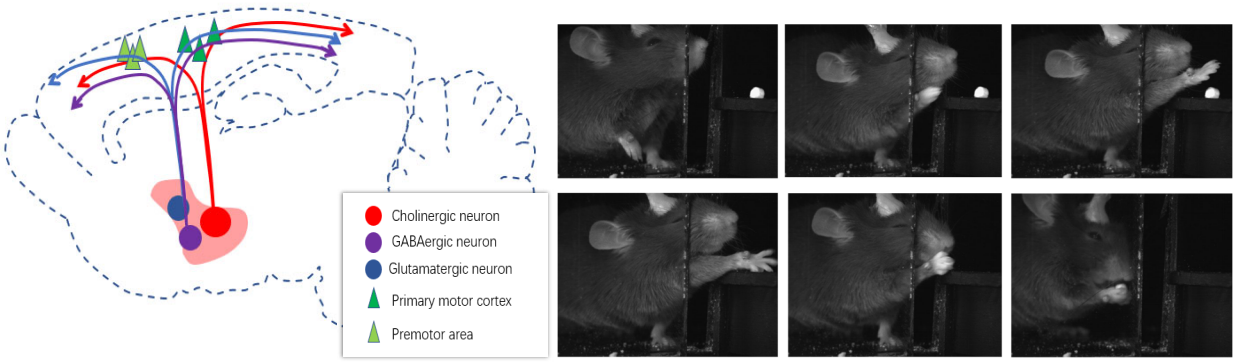
Figure – Methods A) Case 2 electrodes mapped in 3D space in BioImage Suite Electrode Editor. B) Patient-specific cortical segmentations generated by Freesurfer. Cortical areas in Patient A are different from Patient B.

Poster #12 Dane Donegan

Neuromodulation of motor learning and performance mediated by optogenetic stimulation of the basal forebrain

Capstone Committee: John Thompson (chair), Cristin Welle (mentor), Ethan Hughes

ABSTRACT:
The motor cortex is tuned by a variety of neuromodulators that aid in the selection of the correct motor ensembles during motor learning and performance. Acetylcholine (ACh) is one neuromodulator that aids in cortical ensemble activation and tuning of multiple sensory cortices. This work aims to optogenetically stimulate the basal forebrain (BF) cholinergic projection system to enhance the motor acquisition and maintenance of a skilled dexterous forelimb reach task in healthy mice. Optic stimulation of BF cholinergic neurons results in faster skill acquisition and enhanced dexterous skill performance compared to animals that do not receive stimulation. High cholinergic tone severely disrupts learning of the forelimb reach task. Additionally, stimulations paired with failed attempts disrupts skill acquisition, potentially providing evidence that cortical ensembles can be shaped to guide certain actions. Once an animal has learned the forelimb reach task, stimulation can enhance motor performance above an animal's innate skill. The cholinergic system is tuned to a specific intensity-dependent modulatory range, where low and high stimulation intensities do not enhance motor capabilities. Furthermore, BF optic stimulation of a pan-neuronally expressing channelrhodopsin (ChR2), enhances motor performance above cholinergic stimulation alone. These results demonstrate that the BF projection system modulates the motor cortex of a healthy mouse to enhance dexterous motor tasks.



Poster #13 Jacob Feiler

An fMRI Study Examining Inhibition and Threat Vigilance Among Adolescents with Severe Worry

Capstone Committee: Maureen Stabio (chair), Benjamin Mullin (mentor), John Thompson

ABSTRACT:
Severe worry is a common psychiatric phenomenon that increases in prevalence during adolescence and affects multiple aspects of emotion and cognition, including executive function. Inhibition, one domain of executive function, is the ability to suppress particular thoughts or actions in the pursuit of goals and is thought to be mediated by coordinated activity across a network of prefrontal cortical regions. Individuals with severe worry are often hypervigilant for threat, a process which may compete for cognitive resources and contribute to deficits in inhibitory control; these mediating brain processes, however, are poorly understood. In this pilot study, we examined a sample of 36 adolescents, ages 13 to 18, with varying degrees of worry, as measured by the Penn State Worry Questionnaire (PSWQ-C) (Chorpita et al., 1997). We collected fMRI data from each participant, utilizing a mixed block/event-related design and go/no-go paradigm to examine behavioral inhibition under conditions of threat (i.e., unpredictable aversive sound) and non-threat (i.e., no chance of aversive stimuli). Task performance, or sensitivity index, was measured by the variable d', which accounted for a participant's normalized task accuracy (hit rate and false alarm rate). We found that adolescents with and without severe worry demonstrate increased activation in the insula, anterior cingulate cortex, dorsolateral prefrontal cortex, and ventromedial prefrontal cortex during conditions of vigilance for threat. We only found worry severity to be negatively correlated with activation in the dorsolateral and ventromedial prefrontal cortices during vigilance for threat, with no other significant correlations in other regions.

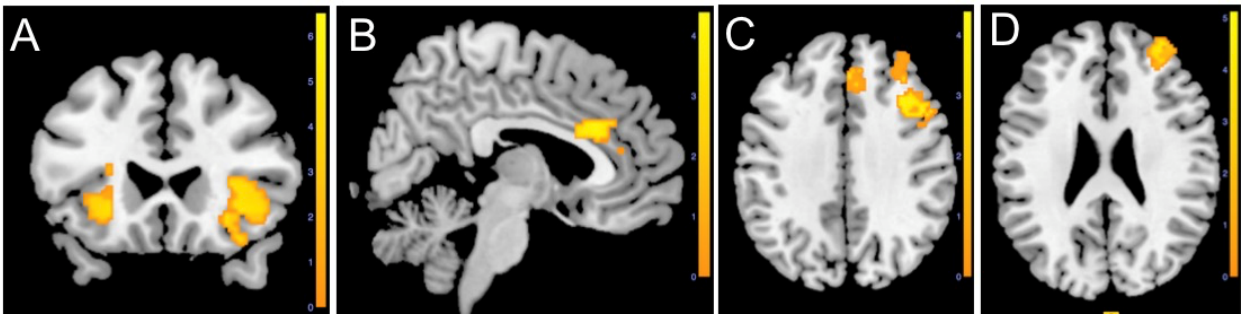


Figure 1. Neuroimaging results from negative>neutral contrast showed significant clusters of activation at p<0.001, FWE-corrected p<0.05 cluster threshold, k>15, in the regions indicated. (A) Insula; (B) Anterior Cingulate Cortex; (C) Dorsolateral prefrontal cortex; (D) Ventromedial prefrontal cortex. Color bars represent t-values.

Poster #14 Daniel Heck

The organization of synaptically convergent Purkinje cells to distinct postsynaptic cell types in the mouse cerebellum

Capstone Committee: John Caldwell (chair), Abigail Person (mentor), Sawako Fukushima

ABSTRACT:
The overall object of this project is to create a 3D model of the cerebellum in order to illustrate the anatomical organization of Purkinje neurons, and to provide a better understanding of how they are integrated into other locations of the brain. Because the communication between the cerebrum and cerebellum is a closed system of polysynaptic circuits, understanding the underlying anatomy and physiology is a significant challenge. Classic staining techniques do not have the resolution nor the sophistication to capture the complete organization of the cerebellar cortex, let alone the entire cerebrocerebellar circuit. To overcome this challenge, a more precise staining technique has been developed to understand the complex functional organization of the cerebellum. Using a genetically modified variant of the rabies virus, neural connectivity can be imaged with extreme detail. The rabies is modified so that the glycoprotein required for the trans-synaptic jump is deleted and replaced with a GFP protein, thus creating the ability to accurately label the connections to a single neuron. As a result of this staining technique, the Purkinje neurons can be traced using the cutting edge tracing software Neurolucida. The traced Purkinje cell somas and their axons can then be rendered in 3D and used for analysis and quantification. Having the ability to visualize the origin of the axons of specific cell types that communicate with the deep cerebellar nuclei in high 3D resolution may begin to provide an understanding of how the input of Purkinje cells is integrated with other excitatory inputs from elsewhere in the brain. Moreover, a 3D model of the cerebellum could also provide a more complete explanation of how the cerebellum quickly and accurately coordinates the inputs and outputs into movement, and is able to predict body movements in space.

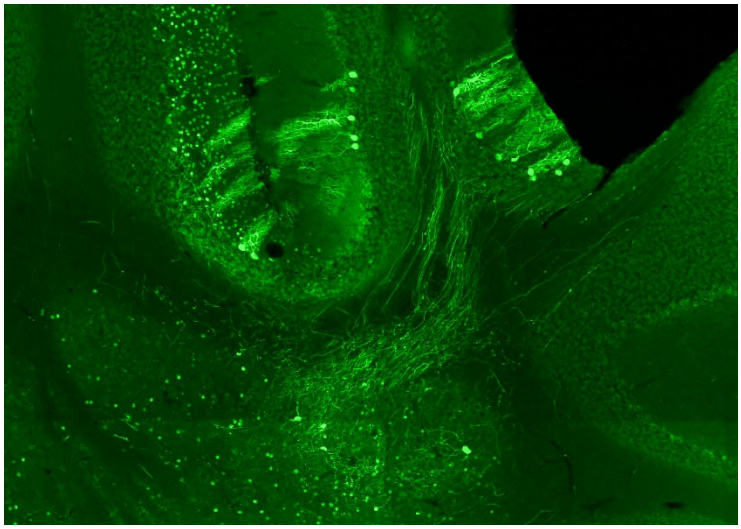


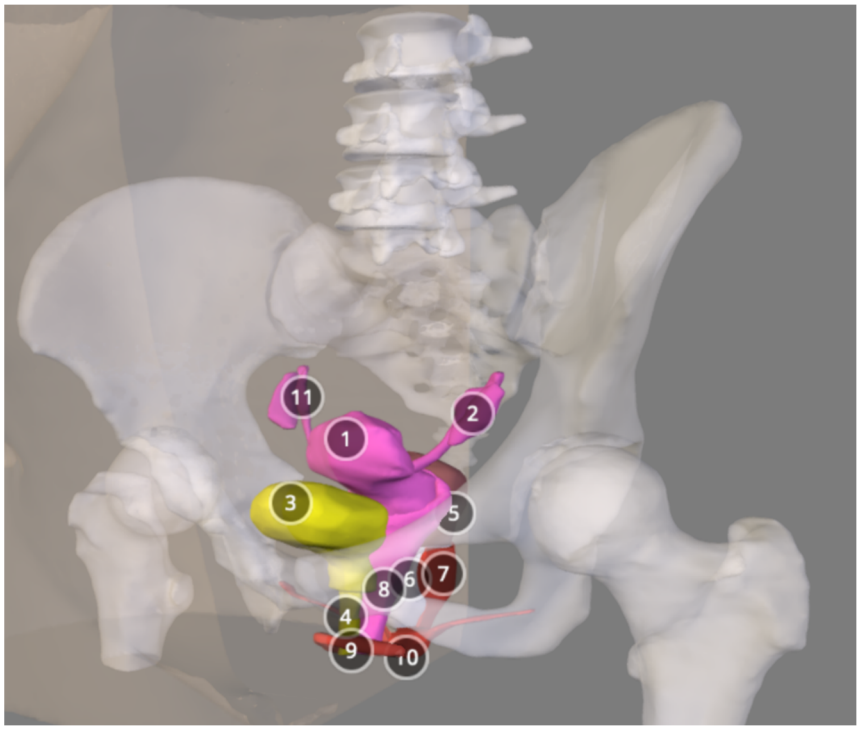
Figure: Cross section of a mouse cerebellum showcasing the monosynaptic rabies virus labeling of Purkinje cells and their axons. The bright green Purkinje somas are organized into longitudinal sheets within the cerebellar cortex and project their axons to the deep cerebellar nuclei (DCN).

Poster #15 Hannah Koury

"I Have a Tear Down There?": Implementing a Three-dimensional Anatomical Education Resource into Post-partum Perineal Laceration Care

Capstone Committee: Lisa Lee (chair), Janet Corral (mentor), Tyler Muffly

ABSTRACT:
Perineal lacerations are a common outcome of vaginal childbirth, with 53-79% of women obtaining some degree of laceration. Despite the high occurrence rate, there is a paucity of educational resources that can be utilized in Obstetrics/Gynecology (OBGYN) clinics to educate women on care of perineal lacerations. The objective was to create a three-dimensional (3D) anatomy tool accessible from a mobile device for health care providers to use when discussing obstetric perineal lacerations with the patient in clinic. An interactive 3D model of the female reproductive organs and perineal structures was created. 3D models were obtained from Touch of Life Technologies (Aurora, CO) and modified to display relevant anatomy. The model was hosted in an online platform accessible from a mobile device with labels highlighting the relevant anatomy. Health care providers (n=31) were surveyed to assess the resource's usability and value. 51.61% of providers stated the resource was essential and 77.42% stated they are likely to recommend the resource to their colleagues. Twenty-four patients were enrolled with a median age of 29 years old [IQR 31, 21.25] and parity of 1 [IQR 3,1]. The resource significantly decreased patient anxiety regarding perineal lacerations ($p<0.01$). In addition, significantly more patients were able to identify the part of their vagina that was injured at the time of delivery following viewing the resource ($p<0.01$). Further revisions of the resource will provide external anatomy for more context and include information/animations on additional common OBGYN complications.

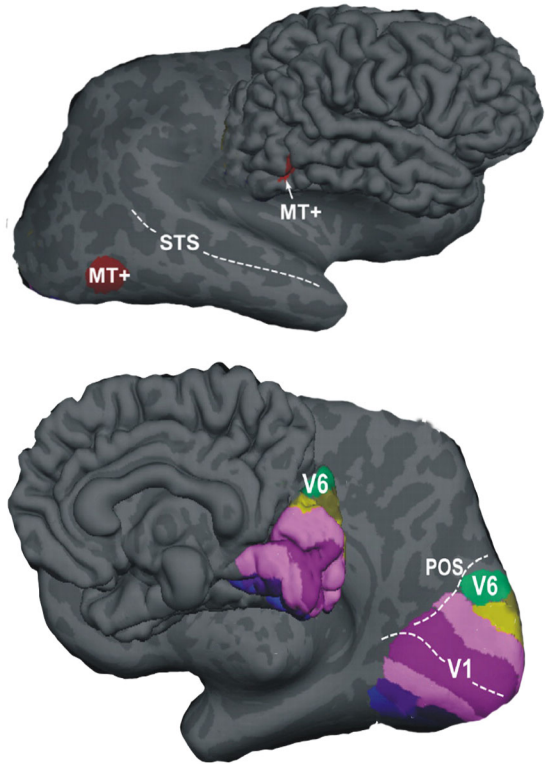


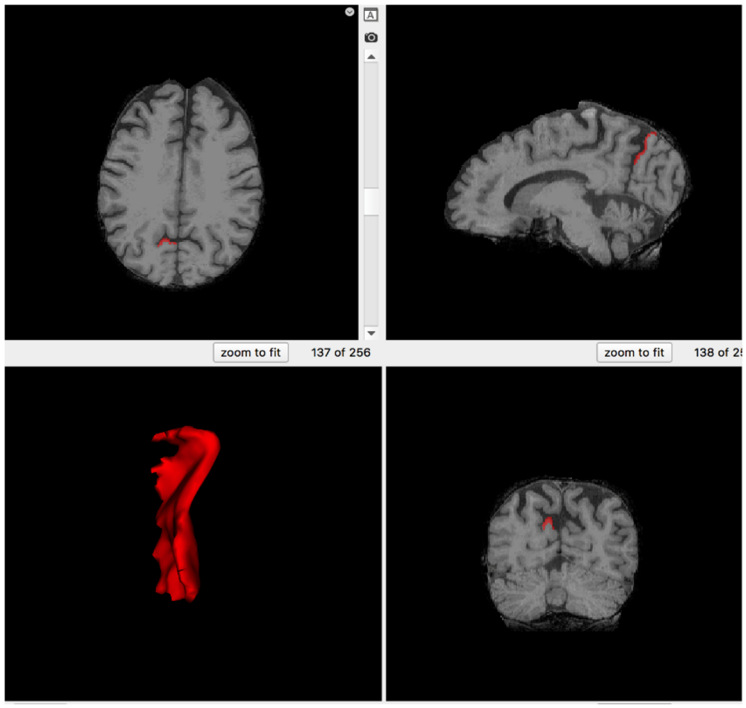
Poster #16 Guttu Maskalo

The relationship between radial optic flow perception and neurodegeneration in Parkinson's Disease: A volumetric MRI analysis

Capstone Committee: John Thompson (chair), Victoria Pelak (mentor), Norma Wagoner

ABSTRACT:
Symptomatic navigational veering in Parkinson's disease (PD) is related to abnormal processing of radial optic flow, which are the motion patterns perceived during forward self-movement. Previous studies indicate an important role of the parietal cortex in the perception of radial optic flow. However, the link between radial optic flow perception, cortical degeneration, and disease severity in PD has not been explored. The aim of this study was to analyze the correlation between three-dimensional radial optic flow perception in PD and cortical degeneration in area V6 of the parietal-occipital sulcus, and V5/middle temporal (MT+) which are important for the analysis of visual motion patterns during self-motion/response to visual motion stimuli, and therefore navigation. We hypothesized that evidence for degeneration in these regions of interest correlates with radial optic flow measures in PD patients. We performed volumetric MRI data analyses on area V6 of the parieto-occipital sulcus and V5/MT+ as the region of interest using Freesurfer on MRI brain images of 19 PD patients. Our results indicate no statistical significance and correlation between ROF and the V6 V5/MT+ areas. However, we observed six additional, white matter cortical structures that show statistically significant MRI volumetric changes in relation to ROF.



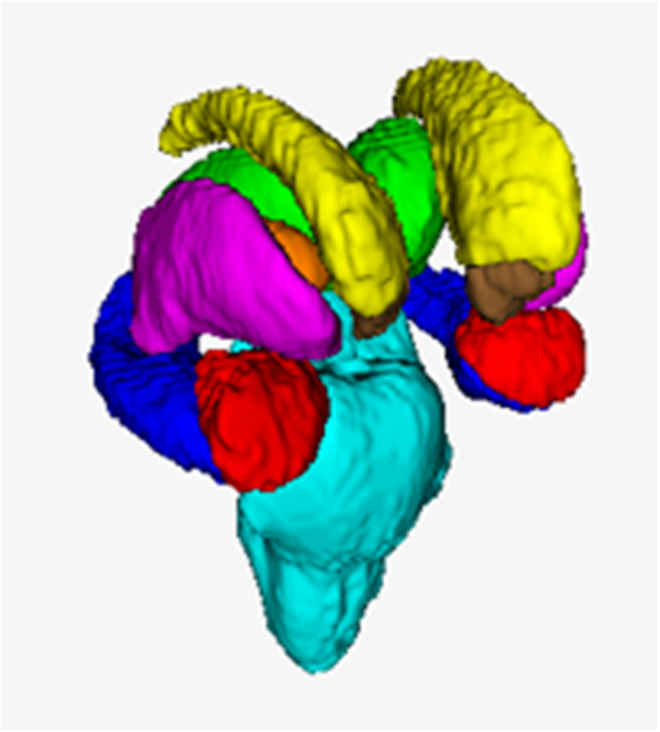


Poster #17 Daniel Uy

Inter-hemispheric analysis of compensatory neural activity and volumetric changes in deep brain stimulation patients

Capstone Committee: John Caldwell (chair), John Thompson (mentor), Aviva Abosch

ABSTRACT:
Parkinson's disease (PD) is a progressive neurodegenerative disorder that is chiefly marked by the progressive loss of dopaminergic neurons, resulting in motor and some non-motor (e.g., olfactory dysfunction) symptoms (Calabresi et al., 2015). The motor related symptoms are a result of the reduction of dopamine caused by the decline in the population of dopamine producing neurons in the substantia nigra of the basal ganglia. Deep brain stimulation (DBS) is a symptom management treatment for pharmaceutically unmanageable Parkinson's disease (PD) because of its ability to improve motor functions and thus quality of life (Martinez-Ramirez et al., 2015). Individuals will typically have two procedures, one hemisphere per surgery, and thus have electrodes implanted in both hemispheres of the brain. In some procedures, the use of electrophysiological evaluation to validate the implant target, provides the unique opportunity to examine changes in neural networks in the human brain. This study sought to examine whether there were changes in neural activity and volume within basal ganglia structures as a function of interhemispheric disruption (DBS), as measured by changes between two independent surgical implantations. The current results display significant DBS induced volumetric change in structures ipsilateral to the implanted hemisphere, and our results also suggest that there is a compensatory increase in contralateral neural activity within basal ganglia structures corresponding with the second implantation surgery.



Poster #18 Carissa Vinovskis

Prevalence of Adrenal Incidentalomas and Assessment of Practitioner Follow Up Per Guidelines

Capstone Committee: Ernesto Salcedo (chair), Lauren Fishbein (mentor), Margaret Wierman

ABSTRACT:

Lesions discovered serendipitously during imaging investigations performed for other purposes are known as incidentalomas. Due to advances in medical technology in the last several decades, and the widespread use of radiographic diagnostic tools, medical practitioners have seen a marked increase in the detection of unexpected lesions unrelated to the patient's chief complaint. Endocrine organs, such as the adrenal glands, very commonly harbor incidentally discovered lesions. In the last twenty years, adrenal incidentalomas have been reported with greater frequency, although the actual occurrence of these nodules in the population is still debated.

When adrenal incidentalomas are discovered during an imaging study, clinicians must evaluate nodules both for the potential of malignancy and hormonal functionality. While the majority of incidentally discovered adrenal nodules are benign, these nodules may result in several concerning diagnoses, which include symptomatically silent endocrine cancers or metastatic lesions from other primary tumors. Functional nodules that cause hypersecretion of adrenal hormones can lead to diseases such as Cushing's syndrome or primary aldosteronism. Even adrenal incidentalomas classified as benign and nonfunctional may be clinically relevant due to moderate increases in hormones that may increase risk for metabolic and cardiovascular disease over time. In 2009, the American Association of Clinical Endocrinologists published medical guidelines for the assessment and management of adrenal incidentalomas. These guidelines recommend both regular imaging and hormonal studies for up to five years after diagnosis, due to the concern that nodules may increase in size or become hormonally active over time.

The aim of this study was first to evaluate the prevalence of adrenal nodules within a population of patients within the University of Colorado Health System in a five-year period. We found that while prevalence of adrenal incidentalomas in our study population was low (0.4%), these nodules can still result in significant medical outcomes in patients, and that understanding the clinical implications of these incidentalomas is critical. We also aimed to evaluate whether practitioners followed up incidentally diagnosed adrenal nodules per the 2009 AACE guidelines, which were the standard of diagnosis and management during our study timeline. We found that a large majority of adrenal incidentalomas diagnosed during our study timeline were not followed up according to the recommended medical guidelines, which suggests that potentially malignant or functional adrenal nodules may have escaped diagnosis by practioners.